Hey guys! Hope your first few weeks have gone well! Exams are just around the corner so let's get some more practice with CH. 14: Ethers, Epoxides, Thiols, and Sulfides and start reviewing CH. 15: Infrared Spectroscopy and Mass Spectrometry.

In-person group tutoring sessions will take place every Wednesday from 6:45 to 7:45 pm in Sid Rich Rm. 75! In these sessions I will provide practice problems and be available for specific questions. To reserve a spot, go to https://baylor.edu/tutoring. I hope to see you there!

Key Words: Epoxides, Ethers, Nomenclature, Infrared, Mass Spectrometry

Starburst Review:

TOPIC OF THE WEEK: Ethers and Epoxides Nomenclature

Nomenclature: There are 2 ways to name Ethers

1. Common= Name each R group, arrange alphabetically, and add ether at the end
2. IUPAC= The ether group acts as an alkoxy substituent and your base is the more complex alkyl or aryl group

Name the structure to the right in both ways before looking at the answer below:
Epoxides are just cyclic ethers, but the nomenclature is slightly different than regular ethers.

1. Common: Add oxide onto the end of whatever the base structure is (imagine the corresponding alkene)
2. IUPAC: Either name the epoxy group as a substituent OR name each substituent and stick oxirane to the end

**HIGHLIGHT #1: ENANTIOSELECTIVE EPOXIDATION**

When making an epoxide, using MCPBA and halohydrins + strong base will make a racemic mixture of products (both enantiomers form in equal amounts)

*Sharpless' catalyst* is comprised of titanium tetraisopropoxide and 1 enantiomer of DET (either + or -). In the reaction, DET serves as a chiral catalyst and will determine if the epoxide is oriented above or below the plane

**HIGHLIGHT #2: IR AND MASS SPECTROMETRY**

<table>
<thead>
<tr>
<th>COMMON IR FUNCTIONAL GROUPS TO KNOW:</th>
<th>Wavenumber (cm(^{-1}))</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>3400</td>
<td>Single hump</td>
</tr>
<tr>
<td>NH(_2)</td>
<td>3400</td>
<td>Double hump</td>
</tr>
<tr>
<td>Alcohol (OH)</td>
<td>3300</td>
<td>Broad, long</td>
</tr>
<tr>
<td>CH</td>
<td>2900</td>
<td>Long, not broad</td>
</tr>
<tr>
<td>Carboxylic Acid (OH)</td>
<td>Midpoint around 2800</td>
<td>Shifts right, very broad</td>
</tr>
<tr>
<td>CN triple bond</td>
<td>2200</td>
<td>Long, skinny</td>
</tr>
<tr>
<td>CC triple bond</td>
<td>2100</td>
<td>Long, skinny</td>
</tr>
<tr>
<td>Carbonyl (C=O)</td>
<td>1650-1750</td>
<td>Short, skinny</td>
</tr>
<tr>
<td>CC double bond</td>
<td>1600</td>
<td>Short, skinny</td>
</tr>
<tr>
<td>Benzene</td>
<td>1600-2000</td>
<td>Baby &quot;Benzene&quot; Bumps</td>
</tr>
</tbody>
</table>

Names of Ether Rings:
- Oxirane (Epoxide) = 3 membered
- Oxetane = 4 membered
- Oxolane (furan) = 5 membered
- Oxane (pyran) = 6 membered
- Dioxane = 6 membered with 2 oxygens at opposite sides
**Mass Spectrometry:**
Ionized molecules break apart in predictable ways. Each time the structure breaks, we have to calculate the weight. Keep "breaking" the structure until you're left with a single CH₃. Use rounded mass values for every atom.

**EX:** How do we create a Mass Spectra for a Pentane molecule?
Before any breaks, Pentane (C₅H₁₂) weighs 72 amu. M⁺ = 72

After a single break, a CH₃ group is broken off with a weight of 15 amu; this initial break is called [M-15]⁺. 72-15 = 57, so the remaining weight is 57 amu.

Maintain this pattern (for each break, another 15 amu is lost).
THINGS YOU MAY STRUGGLE WITH:
1. Naming is challenging! Be comfortable using both classic and IUPAC naming systems. I recommend doing all of the nomenclature problems in the back of the chapter for extra practice.
2. In enantioselective reactions, it's hard to imagine which side the epoxide will face, and what the stereochemistry will look like, so be sure to draw all dashes and wedges IN EVERY SINGLE STEP as to avoid writing the product incorrectly. It's tedious, but it’ll make you successful!

PRACTICE PROBLEMS:

1. SYNTHESIS: Predict the Reagents

   ![Synthesis Reaction Diagram]

2. Name the structure below using both methods to name an epoxide

   ![Epoxide Structure]
ANSWERS TO PRACTICE PROBLEMS:

Ether Nomenclature:
IUPAC: 2-methoxy-2-methylpropane
Common: tert-butyl methyl ether

2. IUPAC: 1,2-epoxy-1-methylcyclohexane
Common: 1-methylcyclohexene oxide

[1] Image from Organic Chemistry Second Semester textbook by Wade
[2] IR figure courtesy of Dr. Zinke’s past SI, Jasmine

All diagrams, tables, and external information is property of Organic Chemistry by David Klein, unless otherwise specified.