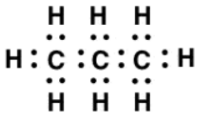
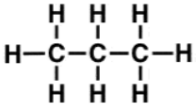
Drawing Organic Structures

Types of Structures of Organic Molecules:

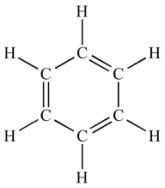
1) **Kekule (AKA structural formula):** Remember in CHEM 150 when you did Lewis dot structures? Kekule structures are very similar, but instead of using two dots to represent a covalent bond between two atoms, you use one line to depict the bond, and you do not need to lone pairs of peripheral atoms.



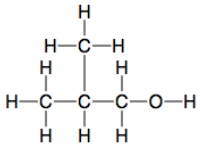
Lewis structure of propane



Kekule structure of propane



Kekule structure of benzene



Kekule structure 2-methyl propanol

2) **Condensed Formulas:** Made up of elemental symbols in which the order of the atoms show the connectivity of the molecule; way of showing molecules explicitly in text form

$CH_3CH_2CH_3$

Condensed formula of propane

(CH3)2CHCH2OH

Condensed formula of 2-methyl propanol

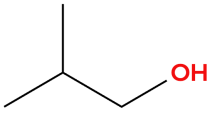
3) **Bond-Line Diagram (aka skeletal or zig-zag formula):** Contains bonds and lines that tend to look like zig-zag lines. This depiction of molecules is most common in organic chemistry because it simplifies complex molecules. This is what we will practice for the rest of the worksheet.



Bond-Line diagram of propane



Bond-line diagram of benzene

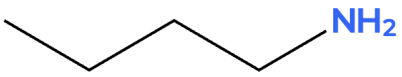


Bond-line diagram of 2-methyl propanol

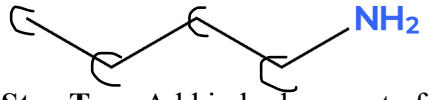
Rules for Drawing Bond-Line (Zig-zag) Structures:

- A bond, which contains two electrons, is represented by 1 line
- Carbon atoms are not normally written, and instead is assumed to be at each intersection between two lines and at the end of each line
- Hydrogens bonded to carbon are not drawn but must be drawn if bonded to every other atom (formally called a heteroatom). This is because we assume that carbon will always have a full octet, we will fill in enough hydrogens for each carbon to fulfil its octet
- Atoms other than carbon and hydrogen are shown
- You don't have to draw lone pairs of electrons on an atom

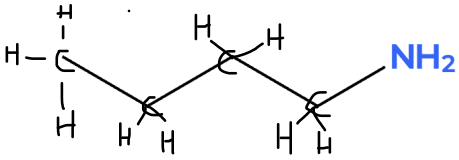
Steps to Converting Bond-Line Drawing to Chemical Formulas:

Example: 

- **Step One:** Wherever there is a vertex or end of a line, draw in a carbon



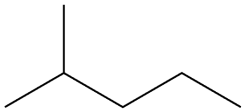
- **Step Two:** Add in hydrogens to fulfill each carbon's octet, that is, make sure carbon has four bonds to it



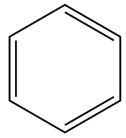
- **Step Three:** Count the number of carbons (x) and hydrogens (y) and list them as such: C_xH_y, and list any other atoms in alphabetical order after the hydrocarbon
    - Number of carbons: 4
    - Number of hydrogens bonded to the carbons: 9
    - Number of heteroatoms: 1, nitrogen
    - Number of hydrogens bonded to the heteroatom: 2
- **Chemical Formula:** $C_4H_9NH_2$

Let's Practice!

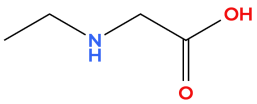
Convert the following Bond-Line Drawings to their Condensed Formula and Chemical Formula

1) 

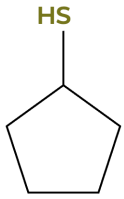
- Condensed Formula:
- Chemical Formula:

2) 

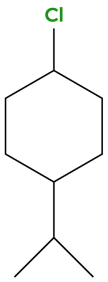
- Condensed Formula:
- Chemical Formula:

3) 

- Condensed Formula:
- Chemical Formula:

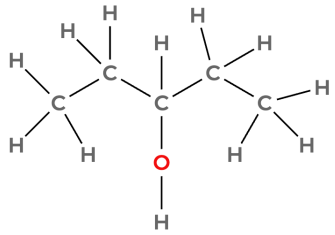
4) 

- Condensed Formula:
- Chemical Formula:

5) 

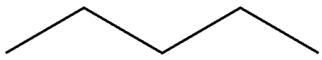
- Condensed Formula:
- Chemical Formula:

Steps to Converting Kekule Structure to Zig-zag structure:

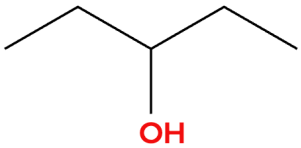


Example:

- **Step 1:** Identify the carbon backbone by determining the number of carbon atoms and how they are connected
    - There are 5 carbons in this structure
- **Step 2:** Draw a Zig-Zag for the Carbon chain (keep the same geometry as what is shown in the Kekule structure)



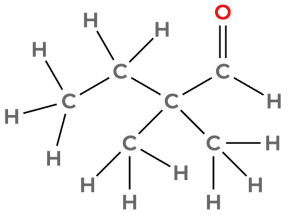
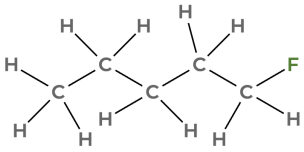
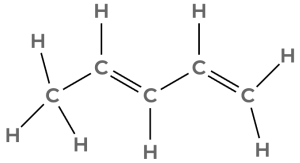
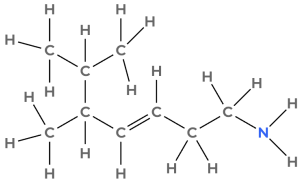
- **Step 3:** If applicable, draw in carbon-carbon double or triple bonds
    - Not applicable in this structure
- **Step 4:** Add heteroatoms and functional groups
    - We have an -OH bonded to the third carbon (this functional group is an alcohol)



* Notice that the hydrogen bonded to the oxygen is explicitly drawn because oxygen is a heteroatom and must be drawn

Let's Practice!

Convert the following Kekule Structure to their Bond-Line (Zig-zag) Structure:

1. 
2. 
3. 
4. 

5. 