



Molecular, Structural & Skeletal Formulas

with Dr. B

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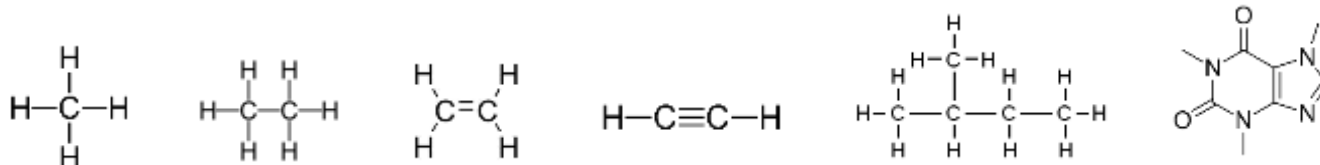
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Table of Contents and Key Skills

- Carbon makes four bonds!
- Writing Molecular, Structural, and Skeletal Formulas
- Visualizing molecules in 3-D.
- Writing Molecular, Structural, & Skeletal Formulas for:
 - Double and triple bonds
 - Cyclic compounds.
 - Compounds with Oxygen, Nitrogen, and Sulfur.
- Practice

Make sure you fully understand that *Carbon makes four (4) bonds!*



Single lines are one bond. Double lines represent two bonds. Triple lines represent three bonds.

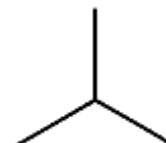
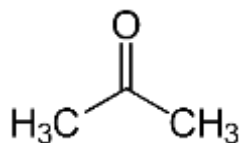
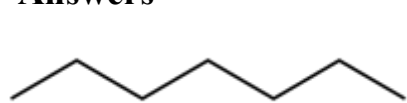
Visualizing Molecules in Different Representations

C_4H_{10} (Butane)	C_4H_9OH (1-Butanol)

Practice: Draw the skeletal structures for each of the following molecular models and write the molecular formulas (e.g. C_2H_6).



Answers



Definitions [\(Watch video on differences.\)](#)

Molecular Formula	Shows the exact number of atoms of each element in a molecule.	C_2H_4	$(CH_3)_2CO$	C_5H_{12}
Structural Formula	Shows how atoms are bonded together in a molecule.			
Skeletal Formula	A simplified version of a structural formula. H atoms bonded to C atoms are not shown.			

Review the examples below, then answer the practice questions at the end of this document.

Examples

How do the different representations show the same molecule?
What are the advantages and disadvantages of each representation?

Molecular Formula	Structural Formula	Skeletal (Bond-Line)
C_6H_{14} 2-Methylpentane 		
C_3H_6O 2-Propanone (or just Propanone) 		

Note: For 2-Propanone we don't show the lone pairs on the Oxygen atom (there are two pairs).
We'll learn that later!

Examples of Double and Triple Bonds

Molecular Formula	Structural Formula	Skeletal (Bond-Line)
C_3H_6 Propene 		
C_5H_8 2-Pentyne		

The number of hydrogen atoms decreases when double or triple bonds are introduced.

Remember, Carbon has four bonds.


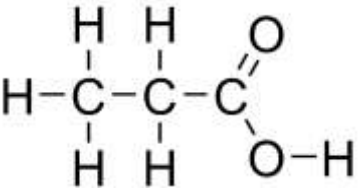
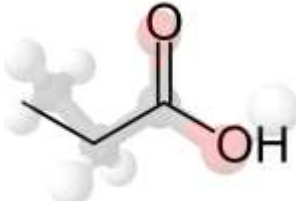

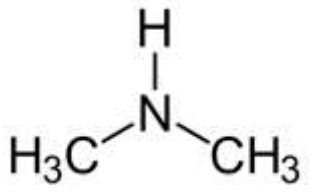

Note that the shape of the molecule with double and triple bonds is different!

Examples of Cyclic Molecules (including Benzene)

Molecular Formula	Structural Formula	Skeletal (Bond-Line)
C_5H_{10} Cyclopentane 		
C_6H_6 Benzene		

	Molecular Formula	Structural Formula	Skeletal (Bond-Line)
Pros	Concise, shows number and types of atoms.	Shows arrangement of atoms.	Provides most info in the least amount of space.
Cons	Doesn't account for isomers or 3-D structure.	Bulky, doesn't show much about 3-D structure.	Requires interpretation to visualize C and H atoms.

Examples with Oxygen, Nitrogen, & Sulfur

Molecular Formula	Structural Formula	Skeletal (Bond-Line)
$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ Propanoic acid 		
$(\text{CH}_3)_2\text{NH}$ Dimethylamine 		

Important: we show H when connected to O, N, or S.

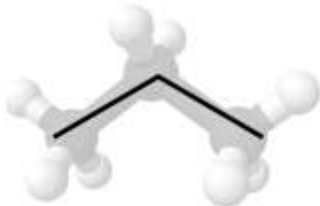
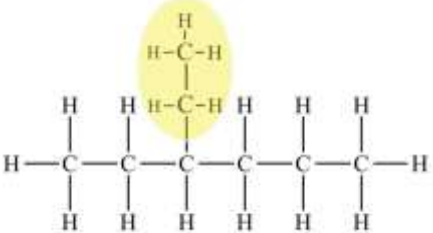
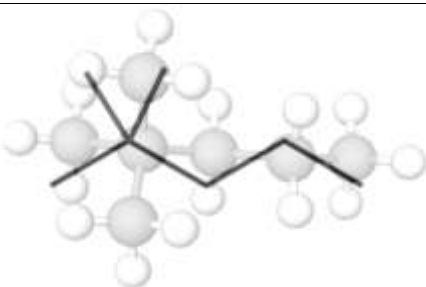
And careful with lines that end in O, N, or S!
The line doesn't end in C.



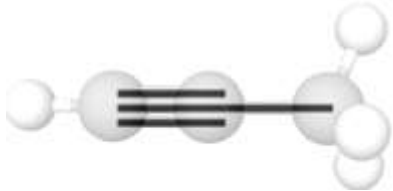
Practice

Fill in the missing Molecular, Structural, or Skeletal formula.

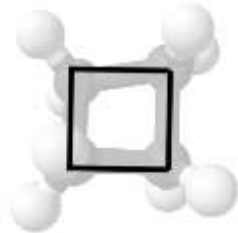
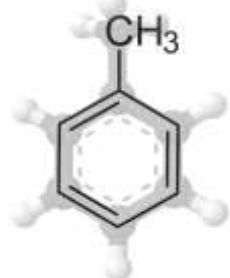
Set 1

Propane		
3-Ethylhexane		
2-2-Dimethylpentane		

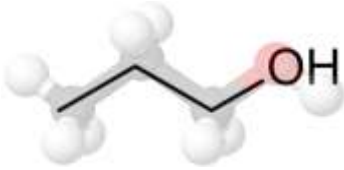
Set 2

Propyne		
2-Butene (trans-2-Butene)	$ \begin{array}{c} \text{H} \quad \quad \text{CH}_3 \\ \diagdown \quad / \\ \text{C} = \text{C} \\ / \quad \quad \diagdown \\ \text{H}_3\text{C} \quad \quad \text{H} \end{array} $	

Set 3

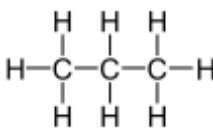
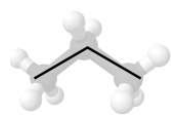
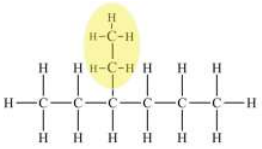
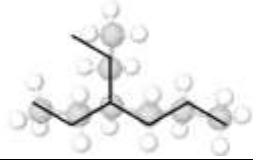
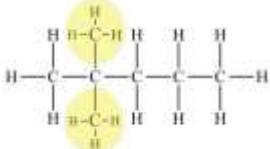

Cyclobutane	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array} $	
Methylbenzene (Toluene) $\text{C}_6\text{H}_5\text{CH}_3$		

Set 4

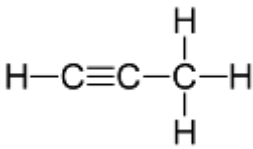
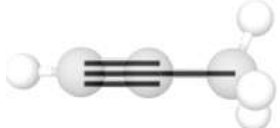
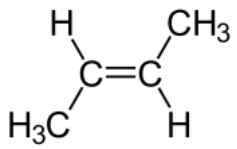

Propanol		
Triethylamine $\text{N}(\text{CH}_2\text{CH}_3)_3$	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{N}-\text{C}-\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ & \text{H}-\text{C}-\text{H} & & \\ & & & \\ & \text{H}-\text{C}-\text{H} & & \\ & & & \\ & \text{H} & & \end{array} $	

Answer Key

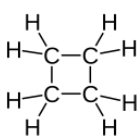
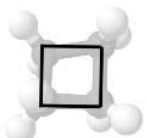
Set 1

Propane C_3H_8		
3-Ethylhexane C_8H_{18}		
2,2-Dimethylpentane C_7H_{16}		

Set 2

Propyne C_3H_4		
2-Butene (trans-2-Butene) C_4H_8		

Set 3

Cyclobutane C_4H_8		
Methylbenzene (Toluene) $C_6H_5CH_3$	