

SI Chemistry - Full Discipline Demo

Stereochemistry 1 - Structural Isomers

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

Terms to match:

- Conformations
- Stereochemistry
- Stereoisomers
- Structural isomers

Descriptions to match:

1. Molecules with identical chemical formulas but with atoms arranged in different orders
2. Molecules with identical chemical formulas but with rotated carbon bonds
3. The study of the arrangement of atoms in molecules
4. Molecules with identical chemical formulas but with atoms differing in three-dimensional orientations

Correct answers:

- 1 Structural isomers 2 Conformations 3 Stereochemistry
4 Stereoisomers

Match each term to the appropriate structural formulas.

⚡ Chain isomer	$\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ & \\ \text{H} & \text{H} \end{array} \quad \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C}-\text{O}-\text{C}-\text{H} \\ & \\ \text{H} & \text{H} \end{array}$	1
⚡ Functional isomer	$\begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{Br} \\ & & \\ \text{H} & \text{H} & \text{H} \end{array} \quad \begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & \text{Br} & \text{H} \end{array}$	2
⚡ Positional isomer	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_3 \end{array} \quad \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	3

Correct answers:

1 Functional isomer 2 Positional isomer 3 Chain isomer

Categorize each type of isomer as being a structural isomer or a stereoisomer.

⚡ Chain	<table border="1"> <thead> <tr> <th>Structural isomer</th> <th>Stereoisomer</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> </tr> </tbody> </table>	Structural isomer	Stereoisomer	1	2
Structural isomer		Stereoisomer			
1		2			
⚡ Functional					
⚡ Geometric					
⚡ Optical					
⚡ Positional					

Correct answers:

1 Chain Functional Positional 2 Optical Geometric

Exploration

_____ is the study of the arrangement of atoms in molecules and the resulting properties of the molecules.

- ☐ Conformation
- ☐ Isomerization
- ☒ Stereochemistry ✓
- ☐ Biochemistry

_____ result when atoms are arranged in a different order.

- ☐ Conformations
- ☐ Stereoisomers
- ☒ Structural isomers ✓

Chain isomers result from the rotations of atoms around single bonds.

- ☐ True
- ☒ False ✓

_____ isomers exhibit identical molecular formulas but the location of functional groups on the carbon skeleton of the molecules differs.

- ☐ Chain
- ☐ Functional
- ☐ Geometric
- ☒ Positional ✓

Alcohols and ethers are examples of ____ isomers.

- ☐ chain
- ☒ functional
- ☐ positional
- ☐ rotational



Exercise 1

Explain the difference between a structural isomer and structural conformations of an organic molecule. List the models that were conformations.

Structural isomers are molecules with the same molecular formula but with a different order of atoms. Conformations are merely twisted versions of molecules that have an identical order of atoms.

Models 2, 4, and 6 were conformations in Part 1. Models 8 and 10 were conformations in Part 2. Models 13 and 15 were conformations in Part 3.

Describe chain isomers and list the models that represent chain isomers.

Chain isomers occurs when the carbon skeleton is arranged differently in molecules with identical chemical formulas. Models 1, 3, and 5 represent chain isomers.

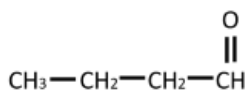
Describe positional isomers and list the models that represent positional isomers.

Positional isomers occurs when functional groups occur in different locations on molecules with identical chemical formulas. Models 7, 9, and 11 represent positional isomers.

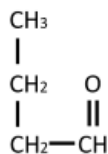
Describe functional isomers and list the models represent functional isomers.

Functional isomers occurs when molecules with identical chemical formulas possess different functional groups. Models 12 and 14 represent functional isomers.

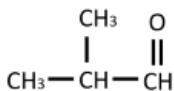
Examine the structural formulas for C_4H_8O below. Which structure is not an isomer of butanal? Explain your answer.



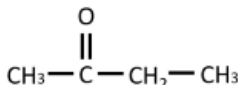
Butanal



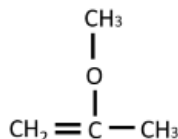
A



B



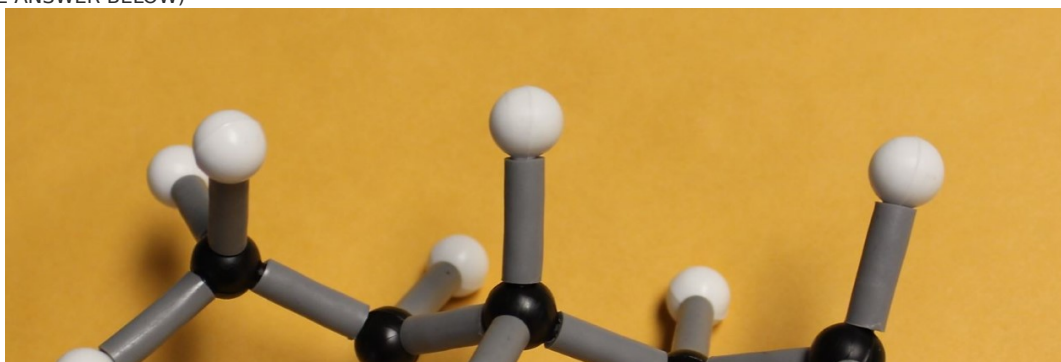
C



D

Structure A is not an isomer of butanal, but a conformation of the molecule. The carbon skeleton, functional group and arrangement of the molecule is identical to butanal and merely represents a twisting of the carbon skeleton.

Photo 1: Unbranched
(SAMPLE ANSWER BELOW)



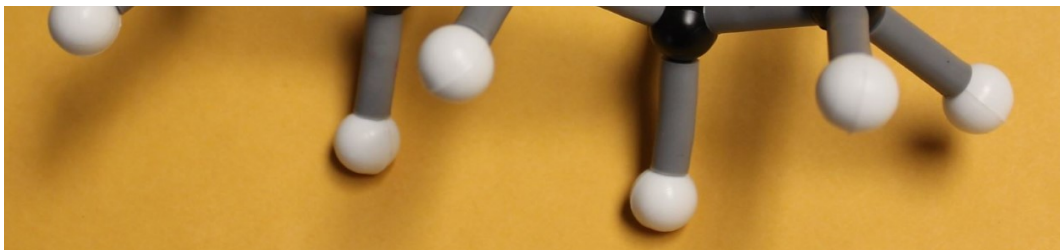
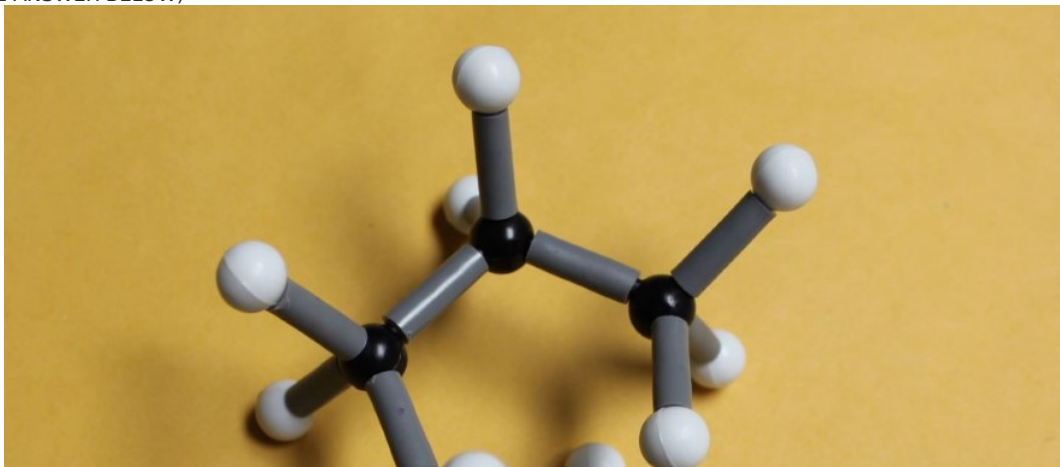
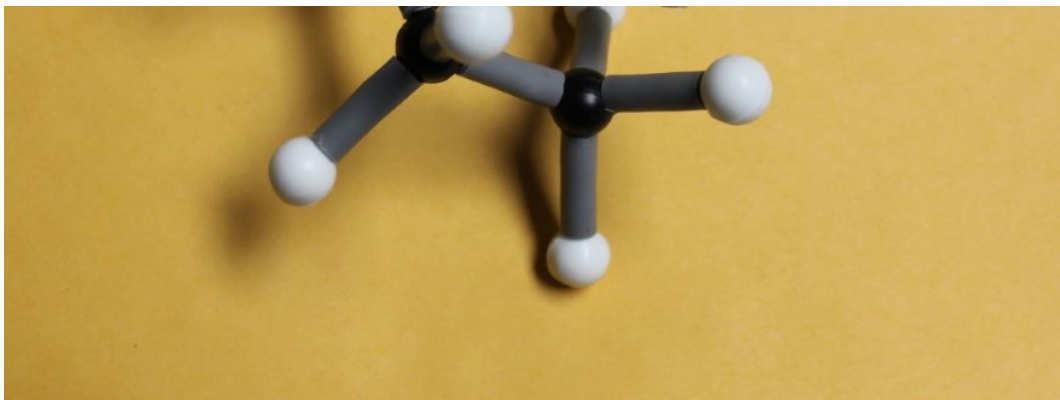


Photo 2: C-shaped
(SAMPLE ANSWER BELOW)





Data Table 1: Simple Hydrocarbon, C₅H₁₂
(SAMPLE ANSWER BELOW)

Name	Isomer Type or Conformation
#1 Unbranched	
#2 C-shaped	Conformation
#3 Branched	Chain Isomer
#4 Arc-shaped	Conformation
#5 Quaternary	Chain Isomer
#6 Rotated quaternary	Conformation

Photo 3: Branched
(SAMPLE ANSWER BELOW)



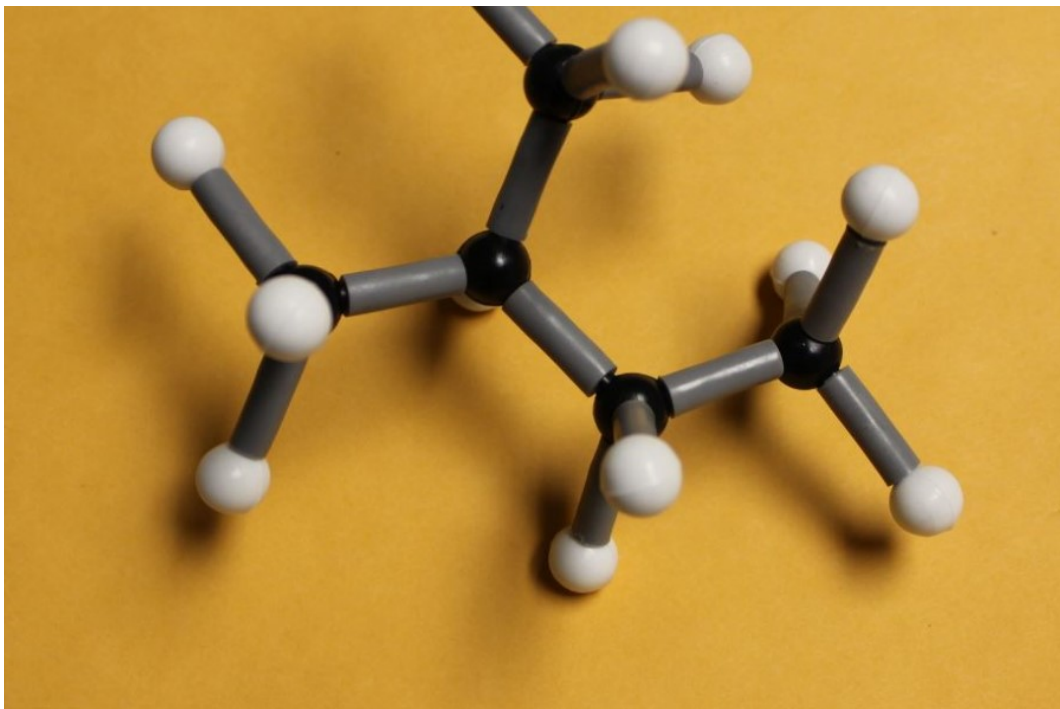
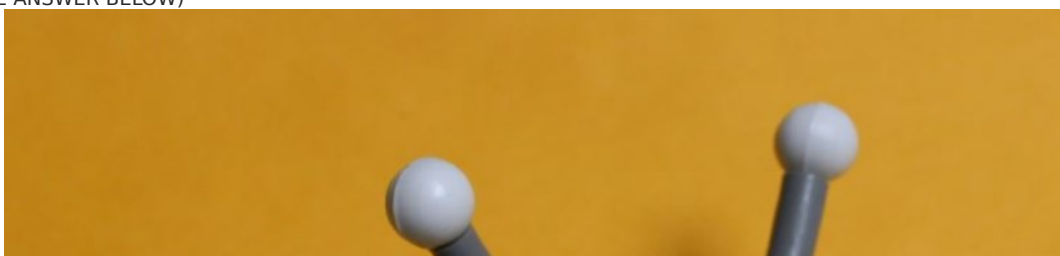


Photo 4: Arc-shaped
(SAMPLE ANSWER BELOW)



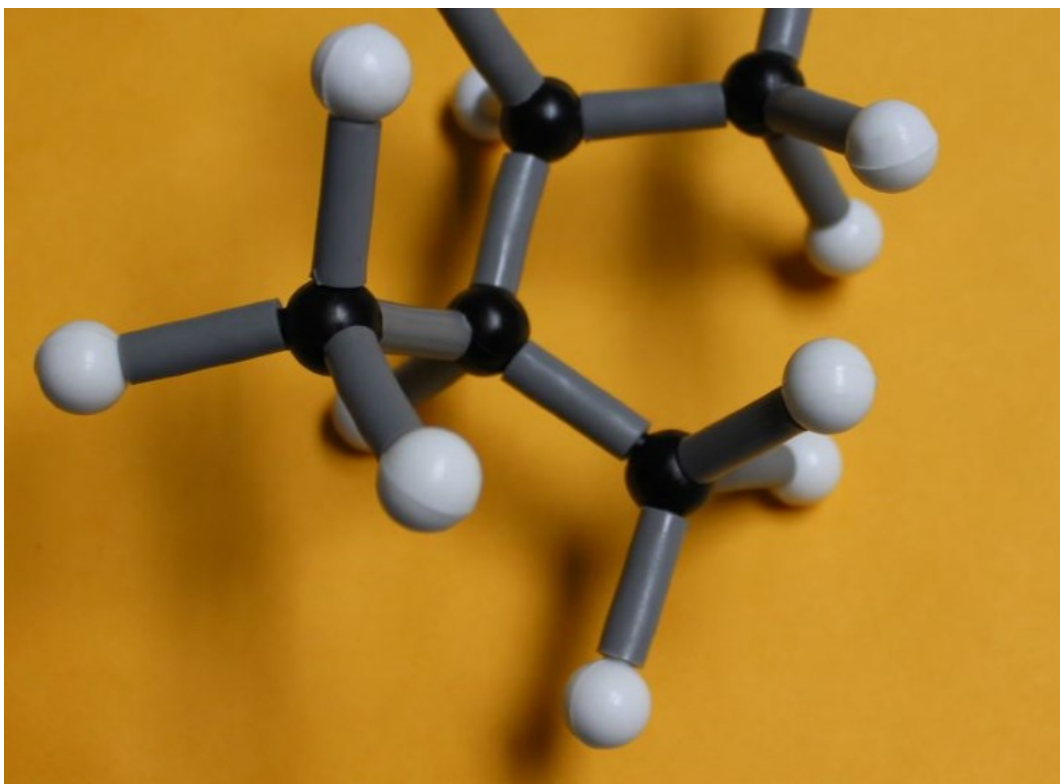
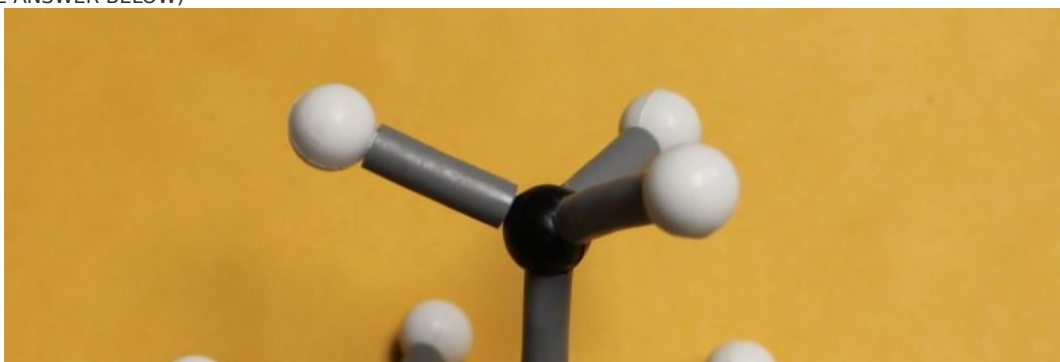


Photo 5: Quaternary
(SAMPLE ANSWER BELOW)



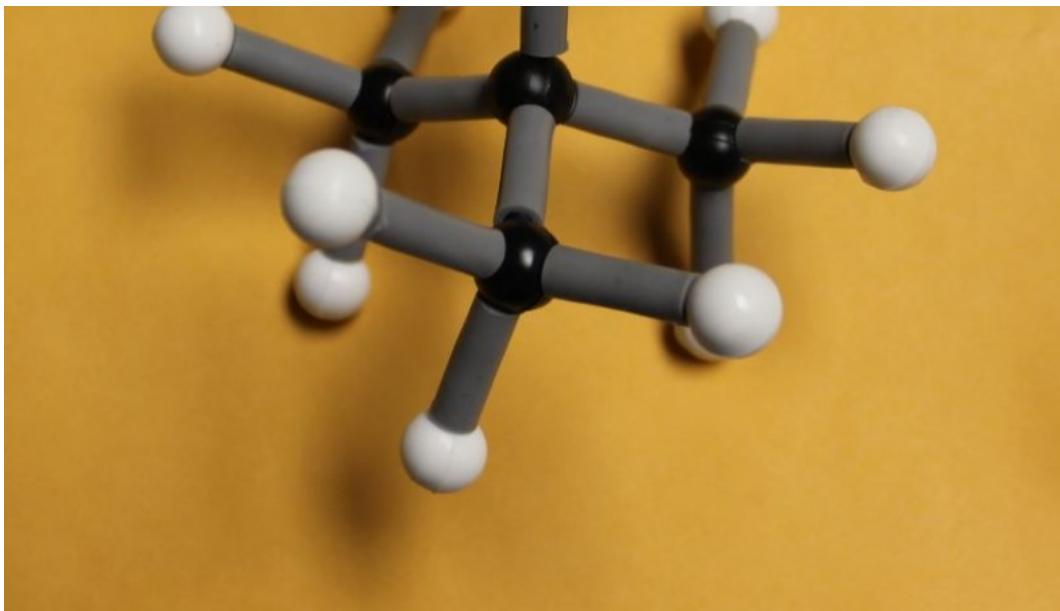


Photo 6: Rotated Quaternary
(SAMPLE ANSWER BELOW)



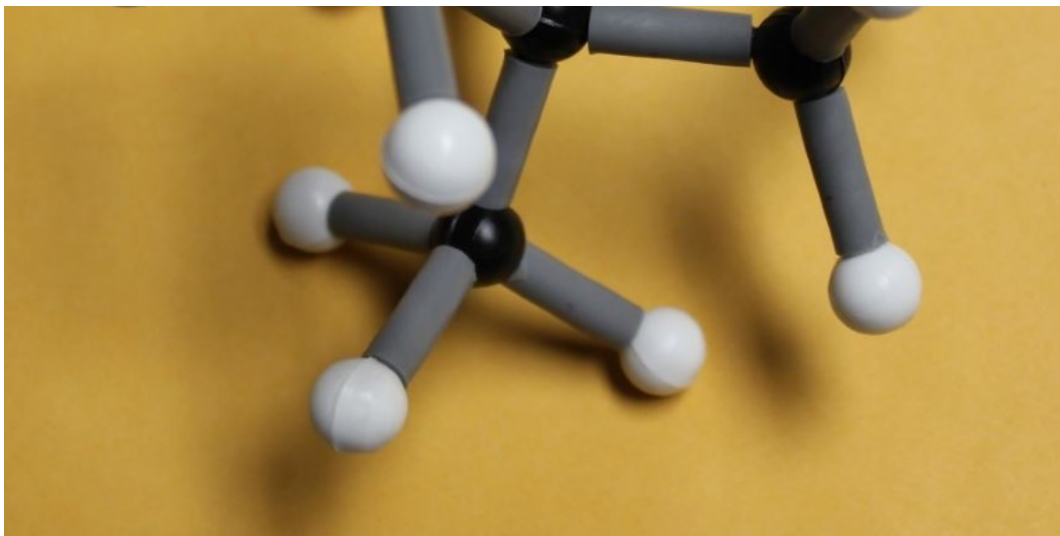
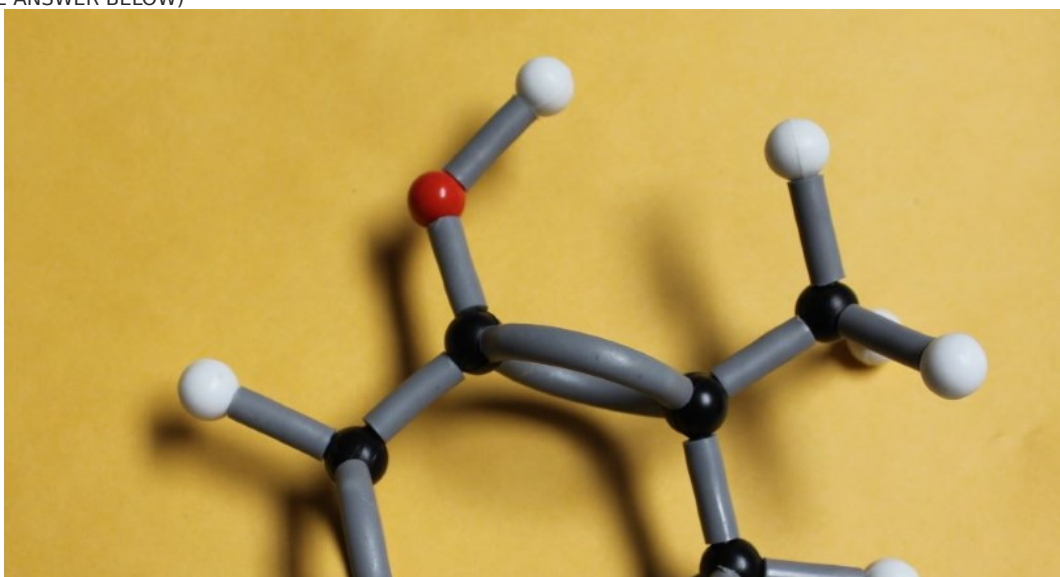


Photo 7: 2-Methylphenol
(SAMPLE ANSWER BELOW)



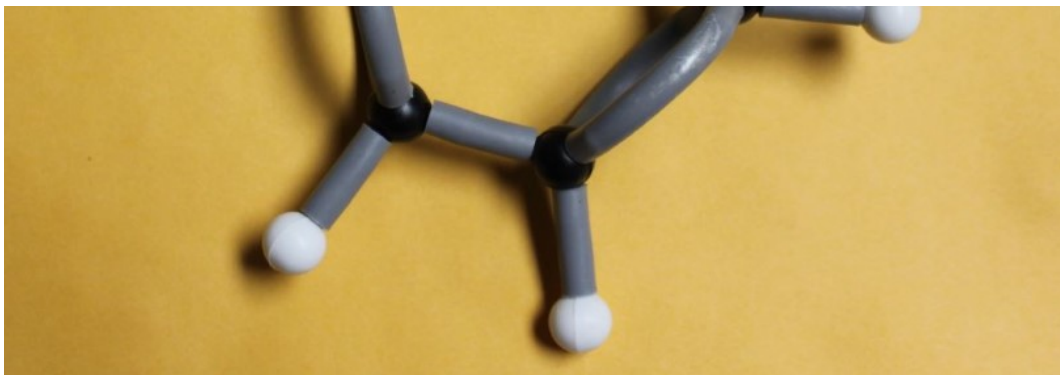
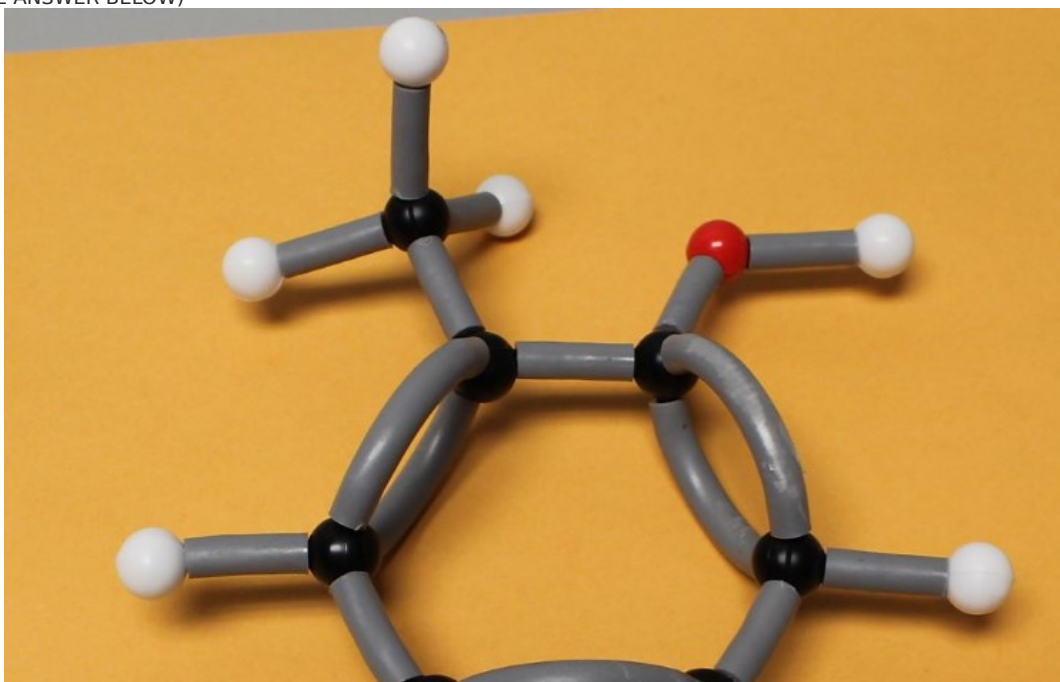
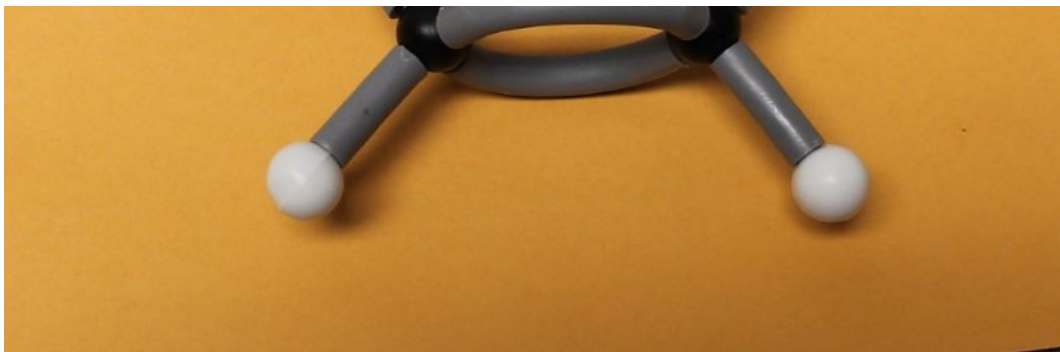


Photo 8: 2-Methylphenol (flipped)
(SAMPLE ANSWER BELOW)

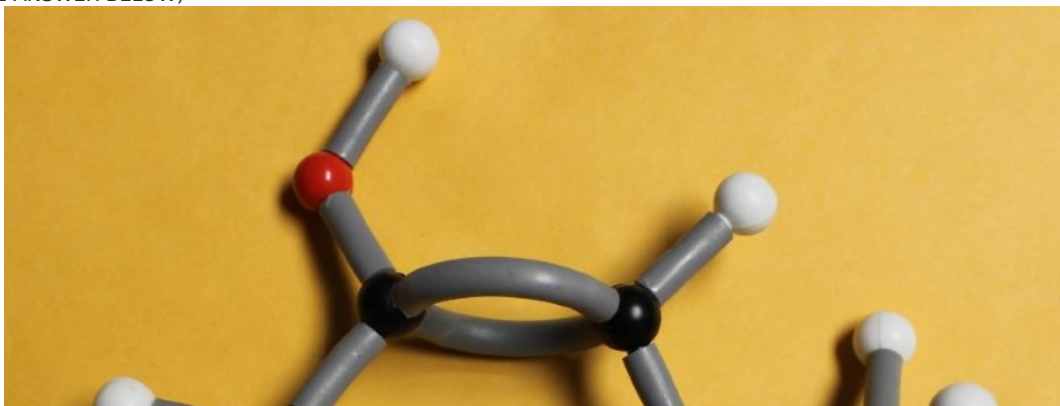




Data Table 2: Aromatic Compound, C₇H₈O
(SAMPLE ANSWER BELOW)

Name	Isomer Type or Conformation
#7 2-Methylphenol	
#8 2-Methylphenol (flipped)	Conformation
#9 3-Methylphenol	Positional isomer
#10 3-Methylphenol (flipped)	Conformation
#11 4-Methylphenol	Positional isomer

Photo 9: 3-Methylphenol
(SAMPLE ANSWER BELOW)



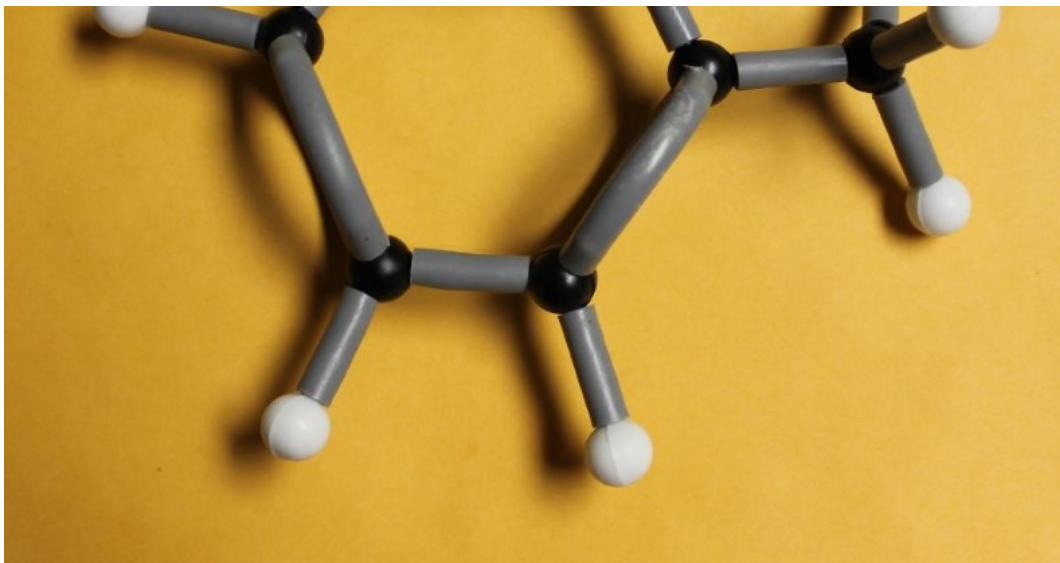
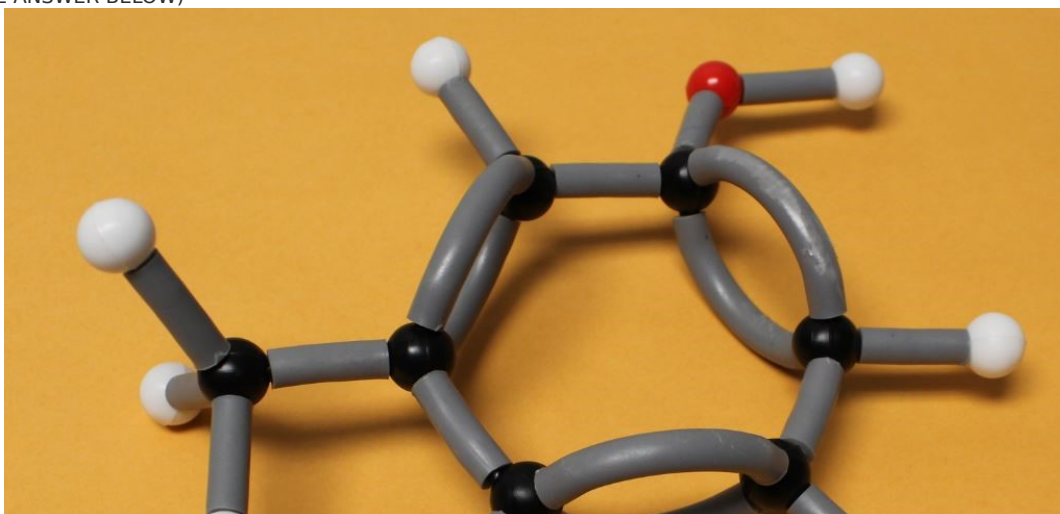


Photo 10: 3-Methylphenol (flipped)
(SAMPLE ANSWER BELOW)



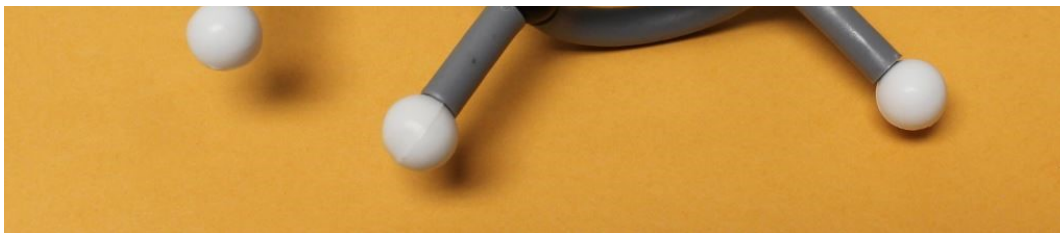
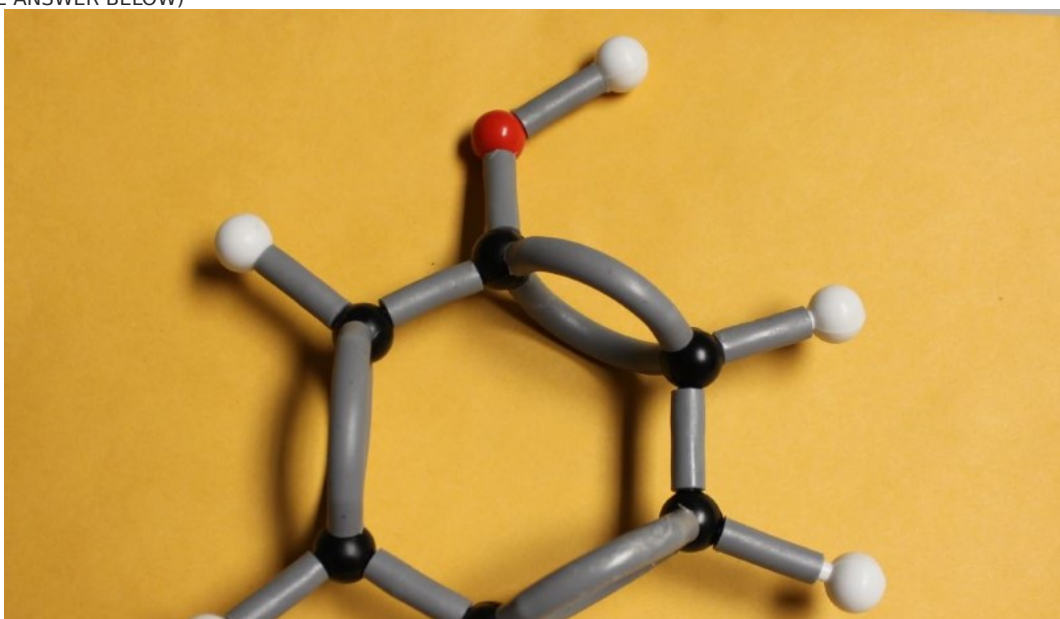


Photo 11: 4-Methylphenol
(SAMPLE ANSWER BELOW)



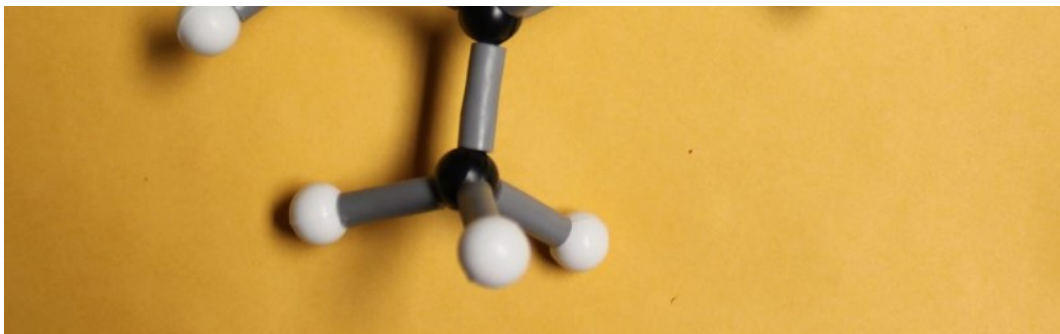
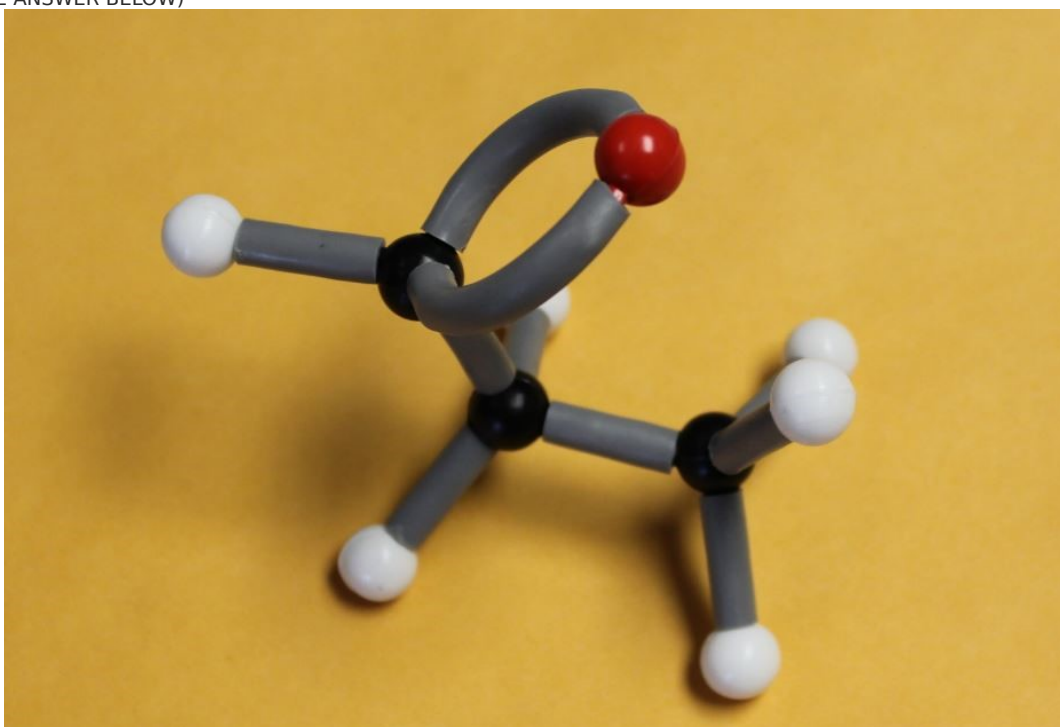


Photo 12: Propanal
(SAMPLE ANSWER BELOW)



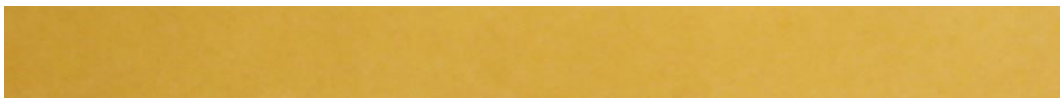
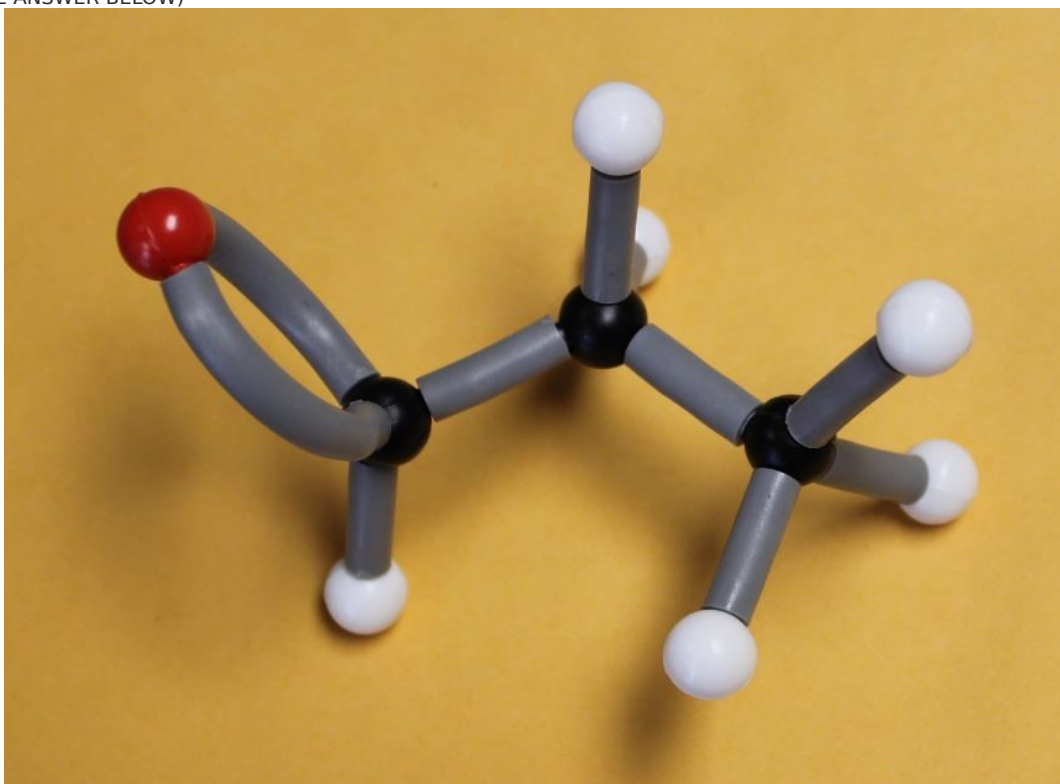


Photo 13: Propanal
(SAMPLE ANSWER BELOW)



Data Table 3: Aldehyde and Ketone, C₃H₆O
(SAMPLE ANSWER BELOW)

Name	Isomer Type or Conformation
#12 Propanal	
#13 Propanal	Conformation
#14 Propanone	Functional Isomer
#15 Propanone	Conformation

Photo 14: Propanone
(SAMPLE ANSWER BELOW)

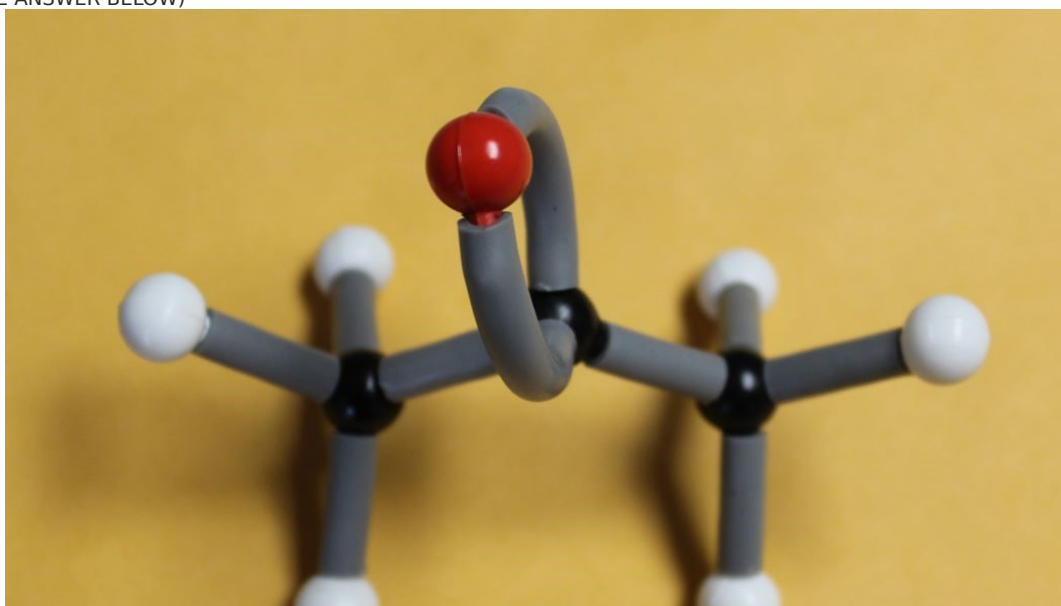
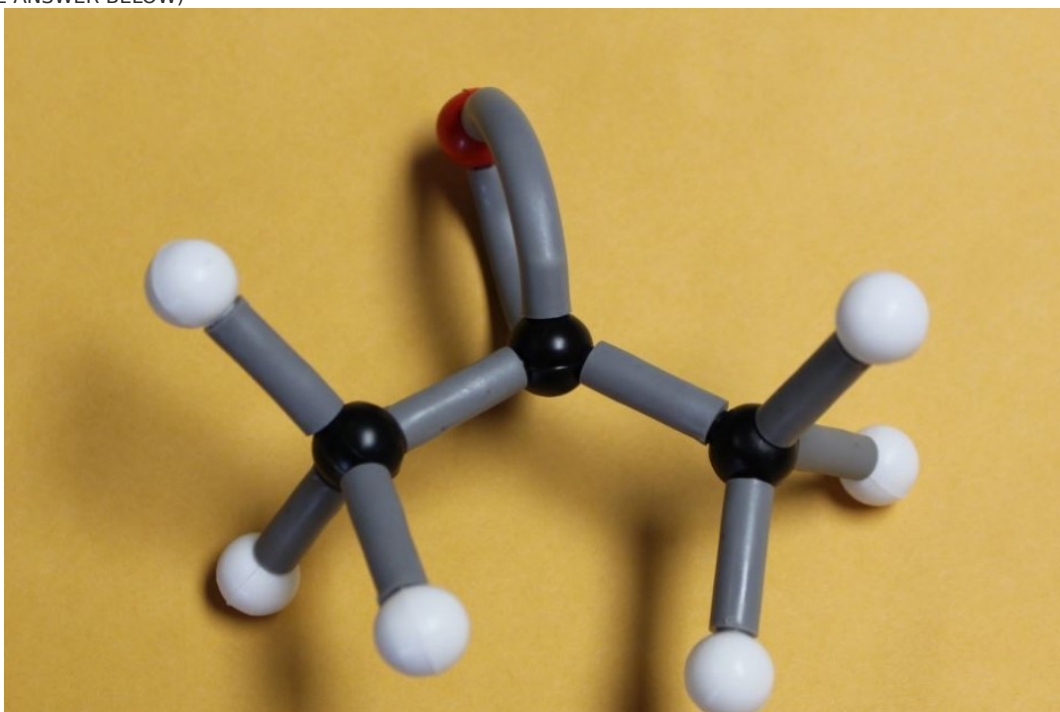
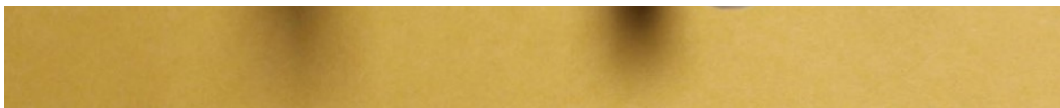




Photo 15: Propanone
(SAMPLE ANSWER BELOW)





Competency Review

Stereochemistry is the study of the ____ of atoms in molecules and the resulting properties of the molecules.

- ☒ three-dimensional arrangement ✓
- ☐ number
- ☐ size
- ☐ mass

Isomers are responsible for the diversity of organic compounds.

- ☒ True ✓
 - ☐ False
-

_____ occur when molecules change shape due to the rotation of atoms around single bonds.

- ☐ Conformations
- ☐ Stereoisomers
- ☐ Structural isomers
- ☐ Positional isomers

✓

Simple hydrocarbons exhibit _____ isomerism.

- ☐ chain
- ☐ functional
- ☐ position
- ☐ None of the above

✓

Positional isomers are molecules with different arrangements of the carbon skeleton but with the same chemical formula.

- ☐ True
- ☐ False

✓

Functional isomers occur when atoms rearrange by _____.

- ☐ altering the carbon skeleton
- ☐ changing the location of functional groups
- ☐ forming different functional groups
- ☐ None of the above

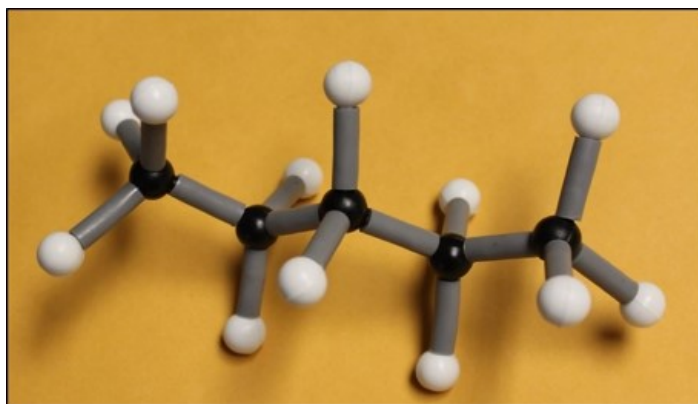
✓

Functional isomers have unique functional groups but identical reactivity.

- ☐ True
- ☐ False

✓

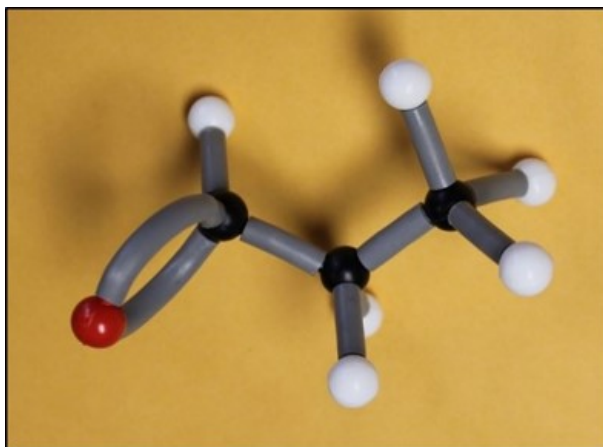
The molecular model pictured below represents a(n) ____.



- ☐ aromatic compound
- ☐ ketone
- ☒ linear hydrocarbon
- ☐ cyclic hydrocarbon

✓

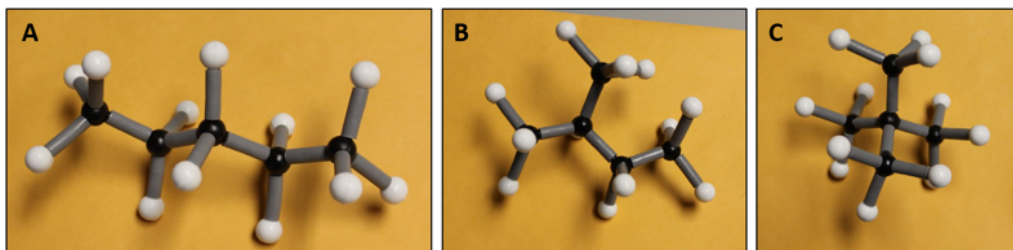
The molecular model pictured below contains a ____.



- ☐ carbon chain
- ☐ carbonyl group
- ☐ methyl group
- ☒ All of the above

✓

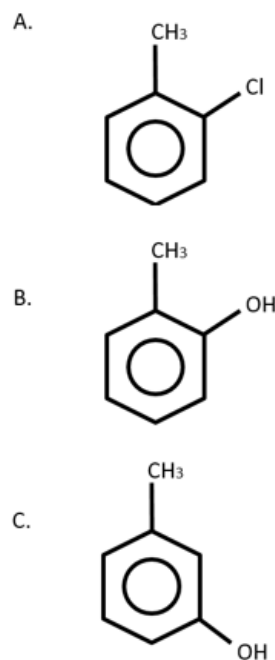
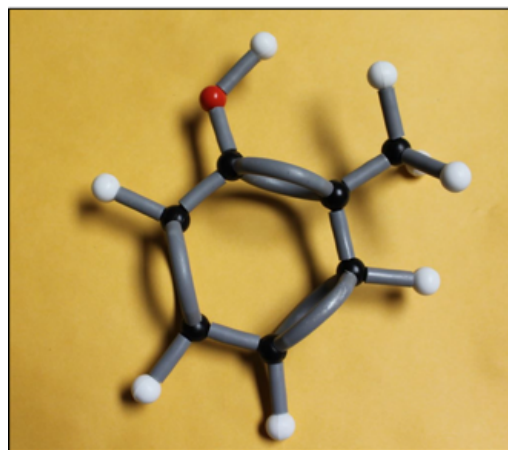
Which of the molecular models pictured below represents an isomer of C_5H_{12} ?



- ☐ A
- ☐ B
- ☐ C
- ☒ All of the above



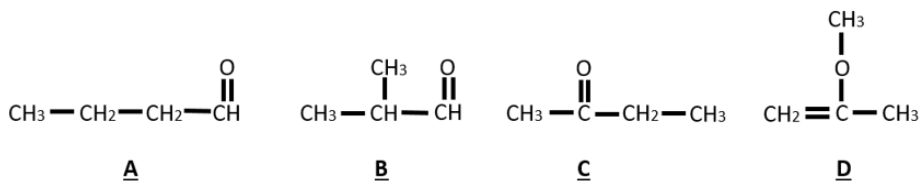
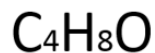
What is the structural formula for the molecular model pictured below?



- ☐ A
- ☒ B
- ☐ C
- ☐ None of the above



Structural formulas ____ and ____ pictured below represent chain isomers.



☐ A; B

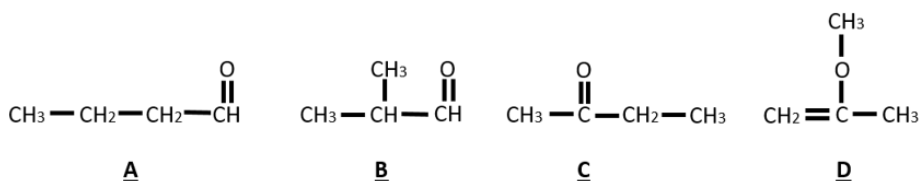
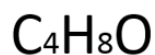
☐ B; C

☐ C; D

☐ A; D



Structural formulas ____ and ____ pictured below represent functional isomers.



☐ A; B

☐ B; C

☐ C; D

☐ A; D



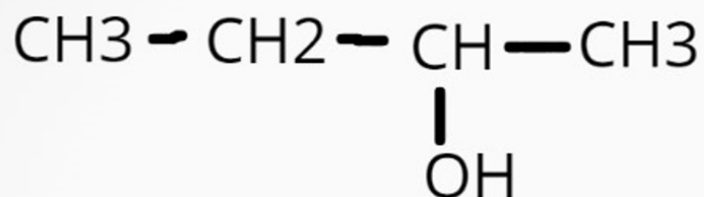
Extension Questions

The chemical formula $\text{C}_4\text{H}_{10}\text{O}$ results in four alcohols and three ethers for a total of seven structural isomers.

Draw pairs of structural formulas for these molecules that illustrate positional and functional isomerism on a sheet of paper. You will be drawing a total of four formulas. Label each pair as positional or functional. Take a photo of the structural formulas and upload the image into the photo panel below.

(SAMPLE ANSWER BELOW)

Positional Isomers



Functional Isomers

