CHEMISTRY 11 UNIT REVIEW: Organic Chemistry

Name: Answer Key

Block: 

TEST DATE: Oct 18th + 19th

A. Give short answers to the following (be careful to give what is asked for):

1. Non-cyclic hydrocarbons having only single C-C bonds are called

2. Draw the structure that is common to all aromatic hydrocarbons

3. Give the formula for the simplest alkene

4. 2-methylbutane and pentane are related to each other; they are _?_ of each other

5. Give the formula for the simplest alkene to have geometric isomers

6. Name the simplest alcohol that has structural isomers

7. Large molecules formed by a simple unit repeating over and over are called

8. Organic compounds typically have low melting points. True or false?

9. A hydrocarbon having double or triple C to C bonds can have H atoms added to it. Such hydrocarbons are said to be...

10. Alkynes can have geometric isomers. True or false?

11. The terms cis and trans are used to distinguish between _?_ of a compound

12. An ester is formed by the joining of an acid and a(n)

13. A functional group gives molecules specific properties. True or false?

14. There is only one possible structure for butanone. True or false?

15. Why are there so many carbon compounds compared to compounds of other elements?

16. alkanes

17. benzene

18. \( C_2H_4 \)

19. isomers

20. \( C_4H_8 \)

21. propanol

22. polymers (due to covalent bonds)

23. unsaturated

24. no (180° bonds)

25. geometric isomers

26. alcohol

27. True

28. True

29. 4 bonds

30. many isomers

31. form long + saturated chains

32. bond covalently with other atoms...

Moving the carbonyl C=O would not change number or compound.

2-butanone
B. Only the carbon skeleton is shown for the following substances. Fully expand these structures (show every atom) and give their chemical formulas (eg. \( C_2H_6 \)).

1. 

\[
\begin{array}{c}
\text{Formula: } C_8H_{12}
\end{array}
\]

2. 

\[
\begin{array}{c}
\text{Formula: } C_{10}H_6
\end{array}
\]

C. Give the structural diagrams for the following substances. Show all atoms attached to the carbons of a double bond. In every other case, omit H atoms.

1. 2,4-dimethylpentane

\[
\begin{array}{c}
\text{CH}_3 \quad \text{CH}_2 \quad \text{CH}_3
\end{array}
\]

2. 4-ethyl-3,3-dimethylhexane

\[
\begin{array}{c}
\text{CH}_3 \quad \text{CH}_2 \quad \text{CH}_3
\end{array}
\]

3. 1-butene

\[
\begin{array}{c}
\text{CH}_2\text{CH}_2\text{CH}_3
\end{array}
\]

4. cis-3-ethyl-2-heptene

\[
\begin{array}{c}
\text{CH}_3 \quad \text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3
\end{array}
\]

5. 2,5-dimethyl-3-hexyne

\[
\begin{array}{c}
\text{CH}_3 \quad \text{CH}-\text{C} \equiv \text{C}-\text{CH}-\text{CH}_3
\end{array}
\]

6. 1,4-dichlorocyclopentane
D. Name these compounds (don’t forget to check for isomers where applicable):

1. 2-methylpentane

2. 2-methyl-5-isopropylheptane

3. 2,3-dimethyl-2-butene

4. 3,4-dimethyl-3-hexene

5. 1,3,5-trimethylcyclohexane

6. 2-butyne

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*triple bond = alkyne*
E. For each of the following, say which functional group the compound represents and give the structural diagram of the compound. (Show carbon skeleton only—leave H’s out except those in functional groups)

1. ethanal
   Functional group: aldehyde

2. propanoic acid
   Functional group: carboxylic acid

3. 2-aminobutane
   Functional group: amine (1°)

4. methoxyethane
   Functional group: ether

5. 3,3-dimethyl-2-hexanone
   Functional group: ketone

6. 1-butyl ethanoate
   Functional group: ester

7. 3-methyl-3-pentanol
   Functional group: alcohol
8.1 Review Questions

1. How is a condensed structural formula different from a carbon skeleton formula? Use an example.

2. Draw carbon skeleton structural formulas for all of the isomers of the alkane with seven carbon atoms. Under each diagram, write the isomer's name.

3. What is the difference between a structural isomer and a geometric isomer? Use an example in your answer.


5. Classify the following as being cis or trans isomers:
   (a)
   \[
   \begin{array}{c}
   \text{H} \\
   \text{H} \\
   \text{C} = \text{C} \\
   \text{C} \\
   \text{CH}_3 \quad \text{CH}_2 - \text{CH}_3
   \end{array}
   \]

(b)
\[
\begin{array}{c}
\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C} = \text{C} - \text{H} \\
\text{H} \\
\text{CH}_2 - \text{CH}_2 - \text{CH}_3
\end{array}
\]

(c)
\[
\begin{array}{c}
\text{C} = \text{C} \\
\text{H} \\
\text{H}
\end{array}
\]

6. An important nutrient for your body is fat. Infants require a diet high in fat for brain development. Your body needs fats for energy and to dissolve certain vitamins. Fats in foods are classified as saturated, unsaturated, and polyunsaturated. Animal products contain a high level of saturated fats. What is meant by the term "saturated"?

7. (a) Unsaturated fats are generally a liquid at room temperature. What is meant by the term "unsaturated"?

   (b) Which of the following are unsaturated: alkanes, alkenes, alkynes, cycloalkanes, aromatics?

8. Classify the following as alkane, alkene, alkyne, cycloalkane, or aromatic without drawing the structure. Some may have more than one classification.
   (a) \( C_5H_{10} \) ______________________
   (b) \( C_{15}H_{32} \) ______________________
   (c) \( C_9H_{16} \) ______________________
   (d) \( C_6H_6 \) ______________________
9. Name the following compounds.
(a) 
\[
\begin{align*}
\text{H} & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_2 \text{CH}_2 \text{C} \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2 \text{CH}_2
\end{align*}
\]
(b) 
\[
\text{CH}_3
\]
(c) 
\[
\text{CH}_3 \quad \text{CH}_2 \quad \text{CH} \quad \text{CH}_2 \quad \text{CH}_3 \\
\text{CH}_3 \quad \text{CH}_2 \quad \text{CH} \quad \text{CH}_2 \quad \text{CH}_3 \\
\text{CH}_3 \quad \text{CH}_2 \quad \text{CH} \quad \text{CH}_2 \quad \text{CH}_3
\]
(d) 
\[
\text{CH}_2 \quad \text{CH} \\
\text{CH}_3 \quad \text{CH}_2 \\
\text{CH}_3
\]
(e) 
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2 \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_2 \quad \text{CH}_3
\end{align*}
\]
(f) 
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2
\end{align*}
\]
(g) 
\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2 \\
\text{CH}_3 & \quad \text{CH}_2
\end{align*}
\]

10. Draw condensed structural formulas for the following compounds.
(a) 4-ethyl-3,5-dimethylnonane
(b) 5,6-dimethyl-3-heptyne
(c) trans-2-heptene
(d) 1,3-dimethyl-2-propylcycloheptane
(e) 4,5,5-trimethyl-2-heptyne
(f) ethylcyclohexane
(g) 4-ethyl-3,3-dimethyloctane
(h) 3-cyclopentyl-5,5-dimethyl-1-hexene
1. A condensed structural formula shows H atoms. A carbon skeleton formula does not. Example: CH₃-CH₂-CH₃ versus heptane

2. 2-methylhexane

3-methylhexane

2,2-dimethylpentane

2,3-dimethylpentane

2,4-dimethylpentane

3-ethylpentane

2,2,3-trimethylpentane

3. Structural isomers – organic molecules with the same chemical formula, but a different placement of atoms.

Geometric isomers – organic molecules with the same structure, but a different orientation across the double bond.

Example: C₆H₁₂
- Structural isomers: 2-methylhexene, and 3-methylhexene
- Geometric isomers: cis-3-hexene, and trans-3-hexene

4. No – because of the two H atoms on the first C atom

5. a. cis  b. trans  c. cis

6. Saturated – molecules that contain double or triple bonds

7. Unsaturated – molecules that contain double or triple bonds. Alkenes, alkynes, and aromatics are unsaturated.

8. a. cycloalkane or alkene
   b. alkane
   c. alkyne
   d. aromatic

9. a. trans-3-heptane
   b. 1,3,5-trimethylcyclohexane
   c. 3,4,4,5-tetraethylheptane
   d. 4-methyl-1-cyclopentyne
   e. 1,4-diethyl-2-methylbenzene
   f. 4-ethyl-2,6-dimethylheptane
   g. 3-methyl-2-hexene
   h. 3-ethyl-4-methyl-1-hexyne

10. a-e
a. 

b. 

c. 

d. 

e. 

f. 

g. 

h.
8.2 Review Questions

1. What elements other than carbon and hydrogen commonly appear in organic molecules?


3. Alkyl halides contain one or more of which family of elements?

4. Complete the following table:

<table>
<thead>
<tr>
<th>Name of group</th>
<th>Atoms and their arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydroxyl</td>
<td></td>
</tr>
<tr>
<td>carbonyl</td>
<td></td>
</tr>
<tr>
<td>carboxyl</td>
<td></td>
</tr>
</tbody>
</table>

5. Name the following compounds:

(a) \( \text{CH}_3\-\text{C}\-\text{CH}_3 \)

(b) \( \text{Br}\-\text{CH}\-\text{CH}_2\-\text{OH} \)

(c) \( \text{Cl}\-\text{C}\-\text{CH}_2\-\text{CH}_3 \)

(d) \( \text{Br} \)

(e) \( \text{CH}_3\-\text{CH}_2\-\text{CH}_2\-\text{CH}_2\-\text{C}\-\text{OH} \)

(f) \( \text{F} \)

6. Draw condensed structural formulae for each compound below.

(a) cyclopentanol

(b) 1,1-dichloroethene

(c) 2-methyl-3-pentanol

(d) 2-chloropropane

(e) 1,1-dichloro-3,3-dimethyl-2-hexanol

(f) 2,3,5-tribromocyclohexanol
7. Both organic and inorganic compounds may contain an \( -OH \) group. In an ionic compound, what is the name of the \( -OH \) group? In an organic compound?

8. Which functional groups contain only the following?
(a) single bonded oxygen atoms
(b) double bonded oxygen atoms
(c) both single and double bonded oxygen atoms

9. How is an amide different than a carboxylic acid? How are they similar?

10. For each of the following compounds named, classify the compound according to its functional group. For some compounds, more than one functional group may be used. Draw condensed structural formulas for as many of these as you can.
(a) 2,3-dichloropentane
(b) 2-decyne
(c) \( \text{trans-3-hexene} \)
(d) 1,2-dimethylbenzene
(e) 2-chloro-2-pentanol
(f) 3-methylbutanamide
(g) propanal
(h) pentanoic acid

11. Classify the following molecules according to their functional group.
(a) \[ \text{CH}_3-\text{CH-} - \text{C}=\text{O} \]
(b) \[ \text{O} \]
(c) \[ \text{CH}_3-\text{C-CH}_2-\text{CH}_3 \]
(d) \[ \text{CH}_3-\text{C-Cl} \]
(e) \[ \text{H-} - \text{C} - \text{C-} - \text{OH} \]
(f) \[ \text{C}_{17}\text{H}_{35}\text{C}=\text{O-O-C}_2\text{H}_5 \]

12. The following molecules are common organic compounds. For each molecule, circle and identify each functional group present. These molecules contain more than one functional group.
(a) vanillin (a food flavoring)
8.2 Review: ANSWER KEY

1. Oxygen and nitrogen are also common in organic compounds.

2. A functional group is an atom, group of atoms, or organisation of bonds in an organic molecule that reacts in a characteristic manner. Examples include alkenes, alkynes, alcohols, ethers, ester, etc.

3. Halogens.

<table>
<thead>
<tr>
<th>Name of Group</th>
<th>Atoms and their arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxyl</td>
<td>![Hydroxyl Structure]</td>
</tr>
<tr>
<td>Carbonyl</td>
<td>![Carbonyl Structure]</td>
</tr>
<tr>
<td>Carboxyl</td>
<td>![Carboxyl Structure]</td>
</tr>
</tbody>
</table>

4. Complete the following table:

5. a. 2,2-dichloropropane
   b. 2-bromo-3-chloro-3-methyl-1-pentanol
   c. 1,2,3,4-tetrachlorocyclobutane
   d. 4-bromo-2-hexene
   e. pentanoic acid
   f. 1,3,5-trifluorobenzene

6. a. [Chemical Structure]

11. a. [Chemical Structure]
   b. Carboxylic Acid
   c. Ketone
   d. Alkyl Halide
   e. Alcohol
   f. Ester
   g. Amine
   h. Amide
   i. Alkene
   j. Ether

12. a. [Chemical Structure]
   b. Alcohol
   c. Carboxylic Acid
   d. Aromatic
   e. Ether

7. In an ionic compound, the –OH group is a hydroxide group. In an organic compound, the –OH group is a hydroxyl group or an alcohol group.

8. a. Alcohols, ethers
   b. Aldehydes, ketones, carboxylic acid, esters, amides
   c. Carboxylic acid, and esters
9. An amide contains a nitrogen atom bonded to a carbon that is double bonded to an oxygen atom. A carboxylic acid does not contain a nitrogen atom. Both amides and carboxylic acids contain a carbon atom that is double bonded to an oxygen atom.