Multiple Choice: (39 points total; 3 points each) Choose the correct answer for each of the following questions. Write the letter clearly in the blank next to each number.

____1. Which of the following molecules is considered an alcohol?

   a) \( \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH}_2-\text{OH} \)  
   b) \( \text{CH}_3-\text{CH}_2-\text{C}=\text{CH}-\text{CH}-\text{CH}_3 \)  
   c) \( \text{CH}_3-\text{CH}_2-\text{OH} \)  
   d) \( \text{CH}_2-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \)  

____2. The reaction of an alkene with water is called a(n) __________________reaction

   a) oxidation  
   b) hydrogenation  
   c) alleviation  
   d) hydration

____3. Which of the following molecules will NOT react with a strong base like \( \text{NaOH} \)?

   a) \( \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH}=#\text{CH}_2 \)  
   b) \( \text{C}_6\text{H}_5-\text{OH} \)  
   c) \( \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_2-\text{C}=\text{OH} \)  
   d) \( \text{HO-C-CH}_2-\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH}_3 \)

____4. What is the correct classification of the following molecule?

   a) ester  
   b) alcohol  
   c) ether  
   d) alkyne
5. Which of the following represents the isopropyl group?

a) CH₃–CH₂–

b) CH₃–CH–CH₃

c) CH₃–CH₂–CH₂–

d) CH₃–CH₂–CH₂–CH₂–

6. What is the correct formula for a compound with the IUPAC name 2-hydroxybutanal?

a)

b)

c)

d)

7. Which of the following molecules is known by the common name formaldehyde?

a) CH₂–CHCH₃

b) 

c) CH₂–CH₂–CH₂–

d) 

8. Which of the following molecules will NOT react with K₂Cr₂O₇?

a)

b)

c) CH₃CH₂–OH

d)

9. Which of the structures below represents the compound pyridine?

a) 

b) 

c) 

d) 

10. A nitrogen atom directly bonded to two hydrogen atoms and one methyl group is considered to be:
   a) an amine      b) a carboxylic acid      c) an amide      d) an ester

11. The correct IUPAC name for the compound pictured below is:

   \[ \text{CH}_2-\text{CH}-\text{CH}_3 \]

   a) propyl benzene      b) 3-isopropylcyclohexene
   c) 3-propylcycloheptene      d) 3-ethylheptane

12. A hemiacetal is the result of the reaction of which combination of reactants below?

   a) an alkene and water
   b) a ketone and water
   c) an alkane and bromine
   d) an aldehyde and an alcohol

13. The hydrolysis of an ester in the presence of a base is known by the name:

   a) hydrobasolysis      b) amidification      c) saponification      d) dehydration

**Short Answer: (61 points total)** Provide the correct answer to each of the following questions. Partial credit will be awarded, so show all of your work.

1. For the molecule below, please follow the following instructions. Draw a circle around every 1° alcohol, a square around every 2° alcohol, and a triangle around every 3° alcohol. (2 pts. each)

   \[ \text{H}_2\text{C}--\text{OH} \]
   \[ \text{HO-CH}_2-\text{CH-CH}_2-\text{CH}_2-\text{CH}_2-\text{C}--\text{CH}_2-\text{CH}_2 \]
   \[ \text{CH}_3\text{CH-CH}_3 \]

2. Please give real examples of the following kinds of molecules NOTE: R is not considered a real atom, so do not use R in your answer (2 pts. each)
a) an ester  

b) an alkyne

3. For the molecule below, locate and circle each chiral carbon center present (2 pts each)

![Chemical Structure](image)

4. Below is a molecule. Draw the correct geometry (3D structure) for the molecule as well as the correct geometry (3D structure) for the enantiomer of the molecule. (4 pts)

![Chemical Structure](image)

5. Provide the correct answer to each of the following questions. Partial credit will be awarded, so show all of your work!

Give IUPAC names for each of the following molecules: (3 pts each)

a) 

b)
6. Draw the molecules described by the following IUPAC names. (3 pts each)
   a) 5-amino-2-hexene  
   b) 4,4-dimethylpentanoic acid
   c) p-ethylphenol

7. The reactions below are missing a product, reactant or a reagent. Fill in the missing data (use real chemical symbols only R, [O], [R], X, etc. are not acceptable in your answers) to make the reaction real correctly. Below each reaction is a question concerning it. Answer the question in the space provided. (5 pts. each = 3 points for reaction + 2 pts for question)
   a)
   \[
   \begin{align*}
   \text{H}_3\text{C} & \text{CH} & \text{CH}_2 & \text{CH}_2 & \text{OH} & \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7, \text{H}^+} & \text{H}_3\text{C} & \text{CH} & \text{CH}_2 & \text{C} & \text{OH} \\
   \text{CH}_3 & & & & & \text{K}_2\text{Cr}_2\text{O}_7, \text{H}^+ & & & & & & & \text{H}_3\text{C} & \text{CH} & \text{CH}_2 & \text{C} & \text{OH} \\
   \end{align*}
   \]
The name of the starting material is: ____________________________________________

b)  
\[
\begin{array}{c}
\text{O} \\
\text{CH}_3 \text{C} \equiv \text{CH}_2 \text{CH}_3 \\
\end{array}
\quad + 
\quad \text{CH}_3 \text{C} \equiv \text{O} \quad \xrightarrow{\text{CH}_3 \text{C} \equiv \text{O} \equiv \text{CH}_2 \text{CH}_3}
\]

Identify the product as an acetal, hemiacetal, ketal, or hemiketal: _____________________________

c)  
\[
\begin{array}{c}
\text{CH}_3 \text{C} \equiv \text{C} \text{H} \\
\text{H} \\
\text{H} \\
\end{array}
\quad + 
\quad \text{H}_2 \\
\quad \xrightarrow{\text{Pt}}
\quad \text{C} \equiv \text{C} \\
\quad \text{H} \\
\quad \text{H}
\]

Is the starting material cis or trans? ____________________________________________

d)  
\[
\begin{array}{c}
\text{CH}_3 \text{C} \equiv \text{C} \text{H}_2 \text{CH}_3 \\
\text{CH}_3 \\
\end{array}
\quad + 
\quad \text{H}_2 \text{O} \\
\quad \xrightarrow{\text{H}_2 \text{SO}_4}
\quad \text{C} \equiv \text{C} \text{H}_2 \text{CH}_3 \\
\quad \text{CH}_3
\]

Does the product you drew obey Markovnikov’s Rule? _____________________________