1) What is the IUPAC name of the compound shown?

\[
\begin{align*}
&\text{CH}_3-\text{CH}-\text{CH}-\text{CH}_2-\text{CH}-\text{CH}_3 \\
&\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\text{CH}_2\text{CH}_3\text{CH}_3
\end{align*}
\]

A) 2-ethyl-3,5-dimethylhexane  
B) 2,4,5-trimethylheptane  
C) 3,5-dimethyl-2-ethylhexane  
D) 5-ethyl-2,4-dimethylhexane  
E) 3,4,6-trimethylheptane

2) The condensed structure of \(n\)-octane is

A) \[
\begin{align*}
&\text{CH}_3\text{CHCH}_2\text{CHCH}_2\text{CH}_3 \\
&\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\text{CH}_3\text{CH}_3
\end{align*}
\]

B) \[
\begin{align*}
&\text{CH}_3\text{CHCH}_2\text{CHCH}_2\text{CH}_2\text{CH}_3 \\
&\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\text{CH}_3\text{CH}_3
\end{align*}
\]

C) \[
\begin{align*}
&\text{CH}_3\text{CHCH}_2\text{CHCH}_2\text{CH}_2\text{CH}_3 \\
&\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\text{CH}_3\text{CH}_3
\end{align*}
\]

D) \[
\begin{align*}
&\text{C}_3\text{H}_3\text{CH}_3\text{CH}_2\text{H}_2\text{C}_3\text{H}_2\text{C}_3\text{H}_2\text{CH}_2\text{CH}_3
\end{align*}
\]

E) \[
\begin{align*}
&\text{CH}_3\text{CHCH}_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \\
&\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\text{CH}_3\text{CH}_3
\end{align*}
\]

3) The molecule shown is named as a substituted ______ because ______.

A) decane; it contains 10 atoms of carbon.  
B) hexane; it contains six atoms of carbon in its longest chain.  
C) hexamethane; it contains six methyl groups altogether.  
D) butane; four carbons are substituted onto the chain.  
E) tetramethane; it contains four methyl groups as branches.
4) What is the IUPAC name of the compound shown?

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

A) 3,5-dimethyl-2-ethylhexane  
B) 2,4,5-trimethylheptane  
C) 3,4,6-trimethylheptane  
D) 5-ethyl-2,4-dimethylhexane  
E) 2-ethyl-3,5-dimethylhexane

5) The various shapes taken on by an organic molecule are known as ________.  

A) conformations  
B) configurations  
C) constitutional isomers  
D) preferential isomers  
E) none of the above

6) The condensed structure of 2,2,4,4-tetramethyl-heptane is  

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

B) \( \text{C}_2\text{H}_5\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{H}_3 \)

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

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

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

7) All of the following are representations of the same molecule except ________.  

A) \( \text{C}_2\text{H}_5\text{CH}_2\text{CH}_2\text{H}_2\text{H}_2 \)  
B) \( \text{C}_4\text{H}_8 \)  
C)
\[
\begin{array}{c}
\text{CH}_2 \quad \text{CH}_2 \\
\text{CH}_2 \quad \text{CH}_2 \\
\end{array}
\]

D) cyclobutane

8) Which molecule is not an isomer of the molecule shown?

\[
\begin{array}{c}
\text{C}_2\text{H}_5 \quad \text{O} \quad \text{C}_2\text{H}_5 \\
\end{array}
\]

A)
\[
\begin{array}{c}
\text{OH} \\
\text{CH}_3 \quad \text{CH}_2 \quad \text{CHCH}_3 \\
\end{array}
\]
9) A correct name for the following compound is:

A) 2-bromo-1-ethyl-2-methyl cyclopropane
B) 1-bromo-3-ethyl-1-methyl cyclopropane
C) 1-bromo-3-ethyl-3-methyl cyclopropane
D) 1-bromo-2-ethyl-1-methyl cyclopropane
E) 1-bromo-1-ethyl-2-methyl cyclopropane

10) In straight-chain alkanes, the carbon atoms on each end of the molecule always form bonds with ________ atoms of hydrogen; the carbons within the molecule always form bonds with ________ hydrogen atoms.

A) 3; 2  B) 4; 2  C) 2; 2  D) 4; 4  E) 3; 3

11) Which list includes all the elements that would be found in an alkane with an amine group?


12) The addition of HF to 2-butene produces

A) 1-fluorobutane.
B) 2,3-difluorobutane.
C) 2-fluorobutane.
D) 1,2-difluorobutane.
E) The reaction doesn't occur.

13) Another name for o-nitrotoluene is

A) 1-nitrotoluene.  B) 2-nitrotoluene.  C) 4-nitrotoluene.  D) 3-nitrotoluene.

14) Which choice represents the carbon skeleton of 1,6-octadiene?

A) C=C=C-C=C-C=C-C
B) C=C=C=C-C=C-C=C
C) C=C=C=C-C=C-C=C
D) C=C=C=C-C=C-C=C
E) C=C=C=C-C=C-C=C

15) When the aromatic ring is named as a side chain or functional group, it is referred to as the ________ group.

A) benzyl  B) phenyl  C) xylyl  D) toluyl  E) benzoyl
16) In the addition of HX to a double bond, the hydrogen goes to the carbon that already has more hydrogens. This is a statement of
A) LeChatelier's principle.
B) the double bond rule.
C) Zatseff's rule.
D) the rule of "less is better".
E) Markovnikov's rule.

17) What is the ideal angle between the H-C-C bond in ethylene?
A) 120°
B) 180°
C) 109.5°
D) 90°
E) none of the above

18) Alkanes and alkenes are similar in all of the following properties except
A) solubility in non-polar solvents.
B) reactivity.
C) insolubility in water.
D) lack of toxicity.
E) flammability.

19) This question has three parts:
a. Sketch the carbon skeleton of 2,5-hexadiene.
b. Explain why this name is not correct.
c. Give the correct name and molecular formula of the compound with the carbon skeleton you drew.

20) Which choice represents the carbon skeleton of 2,4-octadiene?
A) C=C-C-C=C-C=C-C
B) C=C=C=C-C=C=C
C) C=C=C=C-C=C=C
D) C=C=C=C-C=C-C
E) C=C=C=C-C=C-C

21) The name of the polymer formed from CH₂=CH₂ is
A) polyethylene.
B) polystyrene.
C) polyvinyl chloride.
D) polypropylene.
E) none of the above

22) Gentle oxidation of a secondary alcohol will produce
A) an alkene.
B) an aldehyde.
C) a carboxylic acid.
D) an ether.
E) a ketone.

23) Describe and explain the change in water solubility of straight-chain primary alcohols as molar mass increases.
24) Which compound has the **lowest** boiling point?  
A) CH₃CH₂CH₂OH  
B) CH₃CH₂CH₂CH₂CH₃  
C) CH₃CH₂CH₂CH₂OH  
D) CH₃CH₂CH₂CH₃  
E) CH₃CH₂CH₂CH₂CH₂OH  

25) The common name of CH₂(OH)CH₂OH is  
A) glycerol.  
B) grain alcohol.  
C) ethylene glycol (antifreeze).  
D) rubbing alcohol.  
E) wood alcohol.  

26) The most characteristic feature of thiols is ________  
A) reactivity with water  
B) solubility in water  
C) odor  
D) color  
E) boiling point  

27) When phenol acts as an acid, a ________ ion is produced.  
A) phenolic  
B) phenyl  
C) benzyl  
D) phenolate  
E) phenoxide  

28) Oxidation reactions are defined differently in organic chemistry than they are in inorganic chemistry. Give the definition of both and explain their similarities.  

29) The alcohol which contains only one carbon atom and has the common name of wood alcohol is  
A) methanol.  
B) glycerol.  
C) ethanol.  
D) glycol.  
E) phenol.  

30) Strong oxidation of a primary alcohol will produce  
A) a ketone.  
B) an aldehyde.  
C) an ether.  
D) an alkene.  
E) a carboxylic acid.  

31) Which compound is a tertiary alcohol?  
A) 3-hexanol  
B) 1-propanol  
C) 2-methyl-2-hexanol  
D) 2-methyl-1-hexanol  
E) 3-methyl-2-hexanol  

32) Amines are most similar in chemical structure and behavior to  
A) sodium hydroxide.  
B) the hydronium ion.  
C) a primary alcohol.  
D) water.  
E) ammonia.
33) Which compound is an example of an amine salt?  
A) pyridoxine  
B) sulfanilamide  
C) methylammonium chloride  
D) thioacetamide  
E) histamine

34) When an amine behaves as a base it ______ a hydrogen ion to form a(an) _______ ion.  
A) gains; ammonium  
B) loses; hydronium  
C) loses; ammonium  
D) loses; hydroxide  
E) gains; hydronium

35) Which formula best represents the form an amine takes in basic solution?  
A) RNH3+  
B) RNH−  
C) RNH2  
D) RNH2+  
E) RNH2−

36) Which of the following molecules is an example of a secondary amine?  
A)  
B)  
C)  
D)  
E)  

37) Which of these types of compounds forms salts with acids?  
A) ketones  
B) amines  
C) ethers  
D) alcohols  
E) carboxylic esters

38) Which molecule listed is heterocyclic?  
A) pyridine  
B) aniline  
C) naphthalene  
D) benzoic acid  
E) phenol

39) Which molecule is N,N-dimethylpropylamine?
40) All of the following are characteristics of alkaloids except 40) ______
   A) bitter tasting
   B) pleasant smelling
   C) physiologically active
   D) basic
   E) toxic to humans in high doses

41) Which organic functional group is important for its basic properties? 41) ______
   A) carbonyl    B) phenol    C) hydroxyl    D) aromatic    E) amine

42) What is the product of oxidation of 2-butanone? 42) ______
   A) 1-butanol
   B) 2-butanol
   C) butanal
   D) butanoic acid
   E) no reaction

43) Which molecule is formaldehyde? 43) ______
   A) \[ \text{CH}_3\text{C\text{=H}} \]
   B) \[ \text{CH}_3\text{C=CH}_2\text{CH}_3 \]
   C) \[ \text{CH}_3\text{C\text{=H}} \]
   D) \[ \text{CH}_3\text{C=CH}_2\text{CH}_3 \]
   E) \[ \text{CH}_3\text{C=O-CH}_2\text{CH}_3 \]
44) A compound with an -OH group and an ether-like -OR group bonded to the same carbon atom is
   A) a diol.
   B) a hemiacetal.
   C) an aldol.
   D) a simple ether.
   E) an acetal.

45) What is the IUPAC name of the compound shown?

   H–C–CH₂–CH–CH₃
   0    CH₃

   A) 3-methylbutanal
   B) 2-methyl-4-butane
   C) 2-methylbutanal
   D) isopentanal
   E) 2-methyl-1-butane

46) Oxidation of a ketone produces  
   A) an aldehyde.
   B) a secondary alcohol.
   C) a primary alcohol.
   D) a carboxylic acid.
   E) no reaction.

47) Which of the following names does not fit a real compound?  
   A) 4-methylpentanal
   B) ethanal
   C) 3-methyl-2-pentanal
   D) 3-ethylpentanal
   E) All are correct.

48) The reverse reaction of acetal formation is  
   A) esterification.
   B) oxidation.
   C) reduction.
   D) combustion.
   E) hydrolysis.

49) All of the following statements about oxidation of carbonyls are true except  
   A) ketones do not react with mild oxidizing agents.
   B) the Benedict's test involves reduction of Cu²⁺.
   C) the Tollens' test involves oxidation of Ag⁺.
   D) oxidation of aldehydes produces carboxylic acids.
   E) All of the statements are true.

50) What is the product of the oxidation of a ketone?  
   A) an aldehyde
   B) a carboxylic acid
   C) an alcohol
   D) a hemiacetal
   E) None, ketones don't oxidize.
1) B
2) D
3) B
4) B
5) A
6) C
7) A
8) C
9) D
10) A
11) A
12) C
13) B
14) D
15) B
16) E
17) A
18) B
19) a. \(\text{C} = \text{C} = \text{C} = \text{C} = \text{C}\)
   b. This name is not correct because the chain was not numbered from the end that gives the lowest possible number for the first double bond.
   c. This compound should be named 1,4-hexadiene. Its molecular formula is \(\text{C}_6\text{H}_{10}\).
20) C
21) A
22) E
23) As the molar mass of these alcohols increases, the water solubility decreases. This occurs because the polarity of the hydroxyl group, which is the reason for the interaction with the polar water molecules, becomes less important as the size of the nonpolar hydrocarbon portion of the molecule increases.
24) D
25) C
26) C
27) E
28) The inorganic definition of oxidation is loss of electrons. The organic definition is formation of additional bonds between carbon and oxygen (or a decrease in the number of carbon-hydrogen bonds). These are similar because when carbon forms a bond with electronegative oxygen, it essentially loses some of its attraction for its electrons.
29) A
30) E
31) C
32) E
33) C
34) A
35) C
36) A
37) B
38) A
39) C
40) B
41) E
42) E
43) C
44) B
45) A
46) E
47) C
48) E
49) C
50) E