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Organic Chemistry I (CHEM2210) - Practice Hour Exam -1

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Practice Hour Exam 1, Chemistry 2210, Organic Chemistry I

1. Which of the following has a positive charge on the nitrogen atom? Unshared electrons are not shown. Assume all atoms (except H) have an octet of electrons.

   A. \[
   \begin{array}{c}
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{C} \quad \text{C} \quad \text{N} \\
   \text{H} \quad \text{H} \\
   \end{array}
   \]
   B. \[
   \begin{array}{c}
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{C} \quad \text{C} \quad \text{N} \\
   \text{H} \quad \text{H} \\
   \end{array}
   \]
   C. \[
   \begin{array}{c}
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{C} \quad \text{C} \quad \text{N} \\
   \text{H} \quad \text{H} \\
   \end{array}
   \]
   D. \[
   \begin{array}{c}
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{C} \quad \text{C} \quad \text{N} \\
   \text{H} \quad \text{H} \\
   \end{array}
   \]

2. What is the hybridization of the indicated atom in the following species? \((\text{CH}_3\text{CH}_2\text{CH}_2)_3\text{COH}^+\)

   A. \(\text{sp}^3\)  B. \(\text{sp}^2\)  C. \(\text{sp}\)  D. not hybridized

3. Which of the following compounds could produce this IR spectrum?

   A. \[
   \begin{array}{c}
   \text{CH}_3 \\
   \text{CH}_3 \\
   \text{CH}_3 \\
   \end{array}
   \]
   B. \[
   \begin{array}{c}
   \text{CH}_3 \quad \text{N} \\
   \text{CH}_3 \\
   \text{CH}_3 \\
   \end{array}
   \]
   C. \[
   \begin{array}{c}
   \text{CH}_3 \quad \text{OH} \\
   \text{CH}_3 \\
   \text{CH}_3 \\
   \end{array}
   \]
   D. \[
   \begin{array}{c}
   \text{CH}_3 \quad \text{C} \quad \text{O} \\
   \text{CH}_3 \\
   \text{CH}_3 \\
   \end{array}
   \]
4. List all the functional groups in the following compound.

![Chemical Structure]

A. tertiary amine, ketone, secondary alcohol  
B. amide, secondary alcohol  
C. tertiary amine, ketone, primary alcohol  
D. amide, primary alcohol

5. In the following reaction, which species is acting as a base?

![Chemical Reaction]

A.  
B.  
C.  
D. 

6. Which of the following is an allylic carbocation?

![Chemical Structures]

A.  
B.  
C.  
D. 

7. What IR band could be used to distinguish these two molecules?

![Chemical Structures]

A. 2500-3500 cm\(^{-1}\)  
B. 3400 cm\(^{-1}\)  
C. 1750 cm\(^{-1}\)  
D. 2250 cm\(^{-1}\)
8. Which of the following molecules is not an isomer of this alcohol?

![Chemical structures]

A.  
B.  
C.  
D.  

9. What is the IUPAC name of the following molecule?

![Chemical structure]

A. 1-chloro-5-methyl-2-cycloheptene  
B. 1-chloro-4-methylcyclohept-6-ene  
C. 3-chloro-6-methylcyclohept-1-ene  
D. 2-chloro-5-methylcyclohept-1-ene  

10. The bond line structure for the compound \((\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{C(O)CH(CH}_3\text{)(CH}_2\text{)}_2\text{CCH}\) is:

![Bond line structures]

A.  
B.  
C.  
D.  

11. Which is the strongest acid?

A. \(\text{NH}_3\)  
B. \(\text{OH}\)  
C. \(\text{CH}_3\text{COOH}\)  
D. \(\text{HF}\)
12. Which of the following is a pair of resonance structures? Add in missing lone pairs.

A. 

B. 

C. 

D. 

13. What is the correct IUPAC name for the following compound?

A. 1-chloro-4-ethylpentane   B. 1-chloro-4-methylhexane  
C. 3-methyl-6-chloropentane  D. 2-ethyl-5-chloropentane  

14. Which one of these compounds has an IR band at both 2500-3500 cm\(^{-1}\) and 1750 cm\(^{-1}\) but not 3400 cm\(^{-1}\)?

A. 

B. 

C. 

D.
15. Which of the following structures is NOT a resonance structure for this ion?

\[ \ce{\Theta \text{NH}} \]

- A.
- B.
- C.
- D.

16. Which of these acid-base reactions will NOT take place as written?

A. \[ \text{CH}_3\text{CO}_2\text{H} + \text{CF}_3\text{CO}_2\text{Na} \rightarrow \text{CH}_3\text{CO}_2\text{Na} + \text{F}_3\text{CCO}_2\text{H} \]

B. \[ \text{H}_3\text{CC}≡\text{CH} + \text{NaNH}_2 \rightarrow \text{H}_3\text{CC}≡\text{CNa} + \text{NH}_3 \]

C. \[ \text{CH}_3\text{Li} + \text{H}_2\text{C}≡\text{CH}_2 \rightarrow \text{CH}_4 + \text{H}_2\text{C}≡\text{CHLi} \]

D. \[ \text{CH}_3\text{ONa} + \text{CH}_3\text{S}-\text{H} \rightarrow \text{CH}_3\text{O}-\text{H} + \text{CH}_3\text{SNa} \]

17. Arrange these carbon-carbon bonds by bond length, shortest first.

\[ \text{W} \quad \text{X} \quad \text{Y} \quad \text{Z} \]

A. \( \text{Z} < \text{W} < \text{X} < \text{Y} \)

B. \( \text{Z} < \text{W} < \text{Y} < \text{X} \)

C. \( \text{Y} < \text{X} < \text{W} < \text{Z} \)

D. \( \text{X} < \text{Y} < \text{W} < \text{Z} \)
18. Which of these acids will react with CH₃ONa to form CH₃OH (pKa = 15.2)?

\[
\begin{array}{cccc}
\text{HC≡N (pKa = 9.2)} & \text{NH₃ (pKa = 38)} & \text{H₂S (pKa = 7.0)} & \text{HC≡CH (pKa = 25)} \\
\text{I} & \text{II} & \text{III} & \text{IV} \\
\end{array}
\]

A. I only  
B. II only  
C. I and III  
D. II and IV

19. Which statement is correct for the reaction shown here?

\[
\text{O}^- + \text{ } \text{ } \text{???} \rightarrow \text{O}^- + \text{OH} 
\]

A. The reaction is favorable because a weaker base and acid result.  
B. The reaction is unfavorable because a weaker base and acid would result.  
C. The reaction is favorable because a stronger base and acid result.  
D. The reaction is unfavorable because a stronger base and acid would result.

20. Which of the following compounds is least soluble in water?

A.  
B.  
C.  
D.  

21. For the molecule shown, determine hybridization or bond angle of the atoms indicated. The geometry as drawn is not necessarily representative of the true molecular shape.

\[
\begin{array}{cccc}
\text{X} & \text{Y} & \text{Z} \\
\text{W} & \text{hybridization} & \text{bond angle} & \text{hybridization} \\
\text{H₃C} & \text{C} & \text{C} & \text{O} \\
\text{C} & \text{C} & \text{H} & \text{CH₃} \\
\text{H₃C} & \text{C} & \text{CH₂} & \text{CH₃} \\
\end{array}
\]

A. W is sp³; X is sp²; Y is 120°; Z is sp²  
B. W is sp²; X is sp; Y is 120°; Z is sp³  
C. W is sp²; X is sp; Y is 109°; Z is sp³  
D. W is sp³; X is sp; Y is 120°; Z is sp³
22. Which of these is isobutyl bromide?

A. \((\text{CH}_3)_3\text{CCH}_2\text{Br}\) \hspace{1cm} B. \((\text{CH}_3)_2\text{CHCH}_2\text{Br}\)

C. \(\text{CH}_3\text{CH}_2\text{CHBrCH}_3\) \hspace{1cm} D. \((\text{CH}_3)_3\text{CBr}\)

23. What is the IUPAC name of the following molecule?

A. 4-cyclopropyl-5-methylheptane
B. 4-cyclopropyl-3-methylheptane
C. 1-sec-butyl-1-propylcyclopropane
D. 3-methylheptylcyclopropane

24. The IUPAC name of \((\text{CH}_3)_3\text{CCHClCH}_2\text{CH}_3\) is:

A. 3-chloro-4,4-dimethylpentane \hspace{1cm} B. 1-\textit{tert}-butyl-1-chloropropane

C. 3-chloro-2,2-dimethylpentane \hspace{1cm} D. 2-chloro-1,1,1-trimethylbutane

25. Rank the following compounds in order of increasing boiling point (lowest BP first).

A. \(\text{II} < \text{I} < \text{III} < \text{IV}\) \hspace{1cm} B. \(\text{III} < \text{II} < \text{I} < \text{IV}\)

C. \(\text{IV} < \text{III} < \text{I} < \text{II}\) \hspace{1cm} D. \(\text{IV} < \text{I} < \text{II} < \text{III}\)