1. Choose the order of the following C=O groups that are correctly arranged in order of increasing stability due to resonance. (Class Quiz)

A.  
B.  
C.  
D.  
E.  
F.  

increasing stability

\[ \text{CH}_3 \text{C} = \text{H} \text{O} \]  
\[ \text{CH}_3 \text{C} = \text{NH}_2 \text{O} \]  
\[ \text{CH}_3 \text{C} = \text{OH} \text{O} \]

2. Choose the structure most consistent with the formula C₄H₈O₂ and following infrared spectrum.

\[ \begin{align*}
\text{A} & \quad \begin{array}{c}
\text{C} = \text{O} \\
\text{CH}_3
\end{array} \\
\text{B} & \quad \begin{array}{c}
\text{CH}_3 \text{C} = \text{O} \\
\text{H}
\end{array} \\
\text{C} & \quad \begin{array}{c}
\text{H} \text{O} \\
\text{C} = \text{O} \\
\text{H}
\end{array} \\
\text{D} & \quad \begin{array}{c}
\text{O}
\end{array} \\
\text{E} & \quad \begin{array}{c}
\text{OH} \\
\text{C} = \text{O} \\
\text{H}
\end{array} \\
\text{F} & \quad \begin{array}{c}
\text{CH}_3 \text{O}
\end{array}
\end{align*} \]
3. Choose the true statements about the following reaction profile. (class quiz)

\[ HO^- + H^+ + C-\text{Cl} \rightarrow HO-C-H + Cl^- \]

Energy

reaction

1
2
3
R
P

i. Energy difference 1 is related to the rate of the reaction.
ii. Energy difference 2 is related to the equilibrium constant.
iii. If the energy of the reactant (R) is decreased, the reaction goes faster.

A i  B ii  C iii  D i + ii  E i + iii  F ii + iii

4. Choose the answer whose structure is identical to naturally occurring L-malic acid. (Class Quiz)

L-malic acid

A
B
C
D
5. Choose the major species present when the following compounds are added to water and the acidity adjusted to pH = 3.0. (Class Quiz)

\[
\begin{align*}
pK_a &= 4.21 & \text{1} & \rightleftharpoons & \text{2} + H^+ \\
pK_a &= 9.76 & \text{3} & \rightleftharpoons & \text{4} + H^+
\end{align*}
\]

A. 1 + 3  
B. 1 + 4  
C. 2 + 3  
D. 2 + 4

6. Choose the answer that best describes the shape of nitrogen and oxygen in the following structure. (textbook 1.46)

\[
\text{H}_2\text{C}=\text{N}–\text{OH}
\]

A. N (linear), O (linear)  
B. N (angular), O (linear)  
C. N (linear), O (angular)  
D. N (angular), O (angular)  
E. N (trigonal pyramidal), O (linear)  
F. N (trigonal pyramidal), O (angular)

7. Erythromycin is a macrolide antibiotic that has an antimicrobial spectrum slightly wider than penicillin. Choose the structural feature not present in erythromycin. (class quiz)

\[
\text{erythromycin}
\]

A. carboxylic acid  
B. alcohol  
C. ketone  
D. ester  
E. amine  
F. methyl
8. Choose the hybrid orbitals that are used to form the indicated bond on ibuprofen. (Class Quiz)

\[
\text{ibuprofen}
\]

A. Csp\(^2\)-Csp\(^2\)  
B. Csp-Csp\(^2\)  
C. Csp\(^2\)-Csp\(^3\)  
D. Csp\(^3\)-Csp\(^3\)  
E. Csp-Csp

9. Choose the order that has the following compounds correctly arranged with respect to increasing acidity. (textbook 3.32)

\[
\begin{align*}
\text{CH}_3-\text{CH}_2-\text{OH} & \quad \text{i} \\
\text{CH}_3-\text{CH}_2-\text{OH}_2 & \quad \text{ii} \\
\text{CH}_3-\text{O}-\text{CH}_3 & \quad \text{iii}
\end{align*}
\]

A. i < ii < iii  
B. i < iii < ii  
C. ii < iii < i  
D. ii < i < iii  
E. iii < i < ii  
F. iii < ii < i

10. In a synthesis from compounds containing four carbon atoms or less choose the best reactants that would give the following compound.

A. 1 + 3  
B. 1 + 4  
C. 2 + 3  
D. 2 + 4  
E. 1 + 5  
F. 2 + 5

Short Answer

11. Compound A has the molecular formula C\(_3\)H\(_6\)O and the infrared does not show a strong absorption in the 3590-3650 cm\(^{-1}\) or the 1630-1780 cm\(^{-1}\) region.

Give a structure for compound A consistent with this data. 5 pts, (WS3 online quiz, q9)
12. Ritalin is a psychostimulant drug approved for treatment of attention-deficit hyperactivity disorder. Circle the two most acidic hydrogens in Ritalin. 5 pts (Class Quiz)

![Ritalin structure]

13. Draw the product of the following reaction. 5 pts (WS4, q6)

![Reaction diagram]

14. There are four amines with the formula C₃H₇N.
   Among these isomeric amines, give the structure of the amine that would be predicted to have the least solubility in water. 5 pts (WS3 online quiz, q8)

15. Draw the two next best resonance structures (B and C) for the following structure. Circle the better electronic configuration (resonance structure). 10 pts (WS 3)

![Resonance structures]

16. Use the curved arrow formalism to show the bond making and bond breaking that occurs in the following transformation. 10 pts, (textbook, 3.35)

![Transformation diagram]
17. Using the library of synthetic reactions on the cover page, propose a synthesis of the following compound from compounds containing four carbon atoms or less. (Class Quiz) 10 pts

[Diagram of the compound with an arrow pointing to it]

(compounds containing four carbons or less)