1-10) are True or False (20pts)

1) Acid chlorides are good proton donors.

2) Cyclic ketones are called lactones.

3) $K_a$ for Benzoic acid is around $6 \times 10^5$

4) Carboxylic acids can be reduced to primary alcohols by NH$_3$.

5) The Carbon/Nitrogen bond lengths decrease from amines to amides to nitriles.

6) $pK_a = -\log_{10} K_a$

7) Grignard reagents are “organometallic” species.

8) Trichloroethanoic acid is a better proton donor than ethanoic acid.

9) *Trans-esterification* is a reaction where one *ester* is transformed into another *ester*.

10) Isocyanate has the generic formula of RNCO

11) Circle the most reactive molecule with respect to *nucleophilic acyl substitution* in the following threesomes. (6pts)

(a) $\text{H}_3\text{C} - \text{C} - \text{OH}$  $\text{H}_3\text{C} - \text{C} - \text{Cl}$  $\text{H}_3\text{C} - \text{C} - \text{NHCH}_3$

(b) $\text{ }$  $\text{ }$  $\text{H}_3\text{C} - \text{O} - \text{C} - \text{CH}_3$
12) Name the general class of organic compounds that each of these molecules belong to. (12pts)

\[
\begin{align*}
\text{R} & \text{C} \text{O} \text{C} \text{R} & \text{O} & \text{C} \text{N} \text{R}_2 & \text{C} \text{O} \\
\text{R} & \text{C} \text{O} \text{C} & \text{R} & \text{C} \text{N} \text{R}_2 & \text{C} \text{O} \\
\text{R} & \text{C} & \text{R} & \text{C} \text{N} \text{R}_2 & \text{C} \text{O} \\
\text{R} & \text{C} \text{Br} & \text{R} & \text{C} \text{N} \text{R}_2 & \text{C} \text{O} \\
\end{align*}
\]

13) Circle the strongest acid in the following threesomes. (12pts)

(a) \( \text{BeH}_2 \) \( \text{CH}_4 \) \( \text{H}_2\text{O} \)

(b) \( \text{O}_2\text{N} - \text{CO}_2\text{H} \) \( \text{H}_2\text{N} - \text{CO}_2\text{H} \) \( \text{C}_6\text{H}_5\text{CO}_2\text{H} \)

(c) \( \text{CF}_3\text{H} - \text{CO}_2\text{H} \) \( \text{CH}_3\text{CF}_2\text{CO}_2\text{H} \) \( \text{CH}_3\text{CH}_2\text{F} - \text{CO}_2\text{H} \)

(d) \( \text{C}_6\text{H}_5\text{CO}_2\text{H} \) \( \text{C}_6\text{H}_5\text{CO}_2\text{H} \) \( \text{C}_6\text{H}_5\text{OCH}_2\text{Cl} \)
14) Name the following compounds in IUPAC acceptable terms. (18pts)

15) Fill in all the missing products. (12pts)
16) Draw in all the curly arrows for the following mechanism of an acid catalyzed esterification. (8pts)
17) (2+2+2+3=9pts) The following is a saponification reaction.

\[
\text{ester} \xrightarrow{\text{NaOH, } \text{H}_2\text{O}} \text{ester}^+ \text{Na}^- + \text{ester}^- \text{Na}^+ \]

For the above ester:

- How many sp\(^2\) hybridized carbons?

- Which is the most electrophilic carbon?

- Which is the weakest covalent bond?

- Draw the tetrahedral intermediate for this nucleophilic acyl substitution reaction.

18) (3pts) Draw the product of the room temperature reaction shown below.
(HINT it is NOT AN AMIDE).

\[
\text{CH}_3\text{NH}_2 + \text{CH}_3\text{CO}_2\text{H} \rightarrow ?
\]
**Bonus questions** from multiple choice standardized tests* (2+2pts)

50. What is the product of this reaction?

![Chemical Reaction Diagram]

(A) ![Option A](image)

(B) ![Option B](image)

(C) ![Option C](image)

(D) ![Option D](image)

37. What is the major product of this reaction?

![Chemical Reaction Diagram]

(A) ![Option A](image)

(B) ![Option B](image)

(C) ![Option C](image)

(D) ![Option D](image)
Sp 2012 Organic II Exam #3              Ch 20-21              (100 points)

NAME: WHY DID THE WHITE BEAR DISSOLVE IN WATER?

If you do not wish to have your graded exam script placed outside my office, then please check this box □

1-10) are True or False (20pts)

1) Acid chlorides are good proton donors. False
2) Cyclic ketones are called lactones. False
3) K_a for Benzoic acid is around 6x10^5 False
4) Carboxylic acids can be reduced to primary alcohols by NH_3. False
5) The Carbon/Nitrogen bond lengths decrease from amines to amides to nitriles. True
6) pK_a = -log_{10}K_a True
7) Grignard reagents are “organometallic” species. True
8) Trichloroethanoic acid is a better proton donor than ethanoic acid. True
9) Trans-esterification is a reaction where one ester is transformed into another ester. True
10) Isocyanate has the generic formula of RNCO True

11) Circle the most reactive molecule with respect to nucleophilic acyl substitution in the following threesomes. (6pts)

(a) \( \text{H}_3\text{C-C-OH} \) \( \text{H}_3\text{C-C-Cl} \) \( \text{H}_3\text{C-C-NHCH}_3 \)
(b) \( \text{H}_3\text{C-O-C-CH}_3 \) \( \text{H}_3\text{C-O-C-CH}_3 \) \( \text{H}_3\text{C-O-C-CH}_3 \)
12) Name the general class of organic compounds that each of these molecules belong to. (12pts)

\[ \text{R-C-O-C-R} \quad \text{R-C-NR}_2 \quad \text{O} \]

Anhydride \quad \text{Amine} \quad \text{Lactone}

\[ \text{R-C-R} \quad \text{R-C-Br} \quad \text{R-C≡N} \]

Ketone \quad \text{Acid Bromide} \quad \text{Nitrile}

13) Circle the strongest acid in the following threesomes. (12pts)

(a) \( \text{BeH}_2 \quad \text{CH}_4 \quad \text{H}_2\text{O} \)

(b) \[
\begin{align*}
\text{O}_2\text{N-} & \quad \text{H}_2\text{N-} & \quad \text{Ph-} \\
\text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H}
\end{align*}
\]

(c) \[
\begin{align*}
\text{F-} & \quad \text{H-CO}_2\text{H} & \quad \text{H-CF-} \\
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H} & \quad \text{CH}_3\text{CH} \quad \text{H-CF-} & \quad \text{H-CF-} \\
\text{H-CF-} & \quad \text{H-CF-} & \quad \text{H-CF-}
\end{align*}
\]

(d) \[
\begin{align*}
\text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H} \\
\text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H} & \quad \text{Ph-CO}_2\text{H}
\end{align*}
\]
14) Name the following compounds in IUPAC acceptable terms. (18pts)

- 10-Hydroxy-9-methyl decenoic acid lactone
- 3-amino propionic acid lactam
- 4-hydroxy butanoic acid
- Ethanoamide
- Propionyl chloride
- 2-fluorobutyl pentanoate

15) Fill in all the missing products. (12pts)
16) Draw in all the curly arrows for the following mechanism of an acid catalyzed esterification. (8pts)

\[
\begin{align*}
\text{R-C-O-H} & \quad \text{H-X} \\
\end{align*}
\]
17) (2+2+2+3=9pts) The following is a saponification reaction.

For the above ester:
- How many sp² hybridized carbons?
- Which is the most electrophilic carbon?
- Which is the weakest covalent bond?
- Draw the tetrahedral intermediate for this nucleophilic acyl substitution reaction.

18) (3pts) Draw the product of the room temperature reaction shown below. (HINT it is NOT AN AMIDE).

CH₃NH₂ + CH₃CO₂H →?
**Bonus questions** from multiple choice standardized tests* (2+2pts)

50. What is the product of this reaction?

![Chemical Reaction Diagram](image)

- (A) O
- (B) O
- (C) O
- (D) O

37. What is the major product of this reaction?

![Reaction Diagram](image)

- (A) HO
- (B) HO
- (C) HO
- (D) HO