Honor Pledge:

I pledge that I will conduct myself in an ethical manner during the exam. I also pledge that I have neither given nor accepted unauthorized assistance on this test.

Sign your name: ___________________________
1. Provide structures that correspond to the following names. (9 points)

- ethyl 3-oxo-butanoate

- (S) 3-methylhexanenitrile

- (N,p)-diethylbenzamide

2. Provide an enolate and an appropriate electrophile (aldehyde, ketone, ester, alkyl halide, etc.) to add to make the following compounds. (12 points, 4 points each)

- \(\text{OH} \quad \text{O} \quad \text{O} \quad \text{H} \) \(\Rightarrow\) \(\text{C}^+ \quad \text{H} \quad \text{C}^+ \quad \text{H} \)

- \(\text{C} = \text{O} \quad \text{H} \quad \text{C} = \text{O} \quad \text{H} \) \(\Rightarrow\) \(\text{C}^+ \quad \text{H} \quad \text{C}^+ \quad \text{H} \)

- \(\text{O} \quad \text{O} \quad \text{O} \quad \text{H} \) \(\Rightarrow\) \(\text{C}^+ \quad \text{H} \quad \text{C}^+ \quad \text{H} \)

3. Which one of the following esters cannot form an enolate ion? (4 points)

- A) phenyl acetate
- B) \(\text{tert}\)-butyl acetate
- C) ethyl 2-methylbutanoate
- D) ethyl benzoate
4. Which of the following has the fastest rate of hydrolysis to give acetic acid? (4 points)

A) CH₃COCCl₂
B) CH₃CCl
C) CH₃COCH₂CH₃
D) CH₃CNH₂

5. Rank the following in order of decreasing rate of hydrolysis. [faster>slower] (4 points)

I. acetyl chloride  
II. acetic anhydride  
III. ethyl acetate  
IV. acetamide

A) I > III > II > IV  
B) IV > III > II > I  
C) I > II > III > IV  
D) II > III > IV > I

6. Identify the most acidic hydrogen on the following molecule. (4 points)

7. Which one of the following esters gives the Claisen condensation product shown below? (4 points)

A) ethyl 2-methylpentanoate  
B) ethyl 4-methylpentanoate  
C) ethyl 3,3-dimethylbutanoate  
D) ethyl 5-methylhexanoate
8. Which of the following best represents a mechanistic step in the acid-catalyzed hydrolysis of acetonitrile? (4 points)

A) \( \text{H}_3\text{C} - \text{C} \equiv \text{N} : \) \\
\( \text{H} - \ddot{\text{O}} : \) \\
\( \text{H} \)

B) \( \text{H}_3\text{C} - \text{C} \equiv \text{N} - \text{H} \) \\
\( \text{H} - \ddot{\text{O}} : \) \\
\( \text{H} \)

C) \( \text{H}_3\text{C} - \text{C} \equiv \text{N} : \) \\
\( \text{H} - \ddot{\text{O}} : \)

D) \( \text{H}_3\text{C} - \text{C} \equiv \text{N} : \) \\
\( \text{H} - \ddot{\text{O}} : \) \\
\( \text{H} \)

9. Draw a molecule that is consistent with the data set found in the supplemental handout. (9 points)

\[ \text{O} - \text{C} \equiv \text{N} \]
10. Provide the major organic product. Include stereochemistry where appropriate. (24 points, 3 points each)
11. Using propene and diethylmalonate as your only carbon sources, propose a multistep synthesis that can carry out the following transformation. In addition to reaction arrows with reagents, include the structure of the starting materials, products, and any synthetic intermediate. No mechanisms please. (10 points)

12. Using curved arrows to denote electron movement, provide a mechanism to show how the following saponification reaction occurs. (10 points)
Problem 9

IR Spectrum (liquid film)

4000 3000 2000 1600 1200 800
V (cm⁻¹)

Mass Spectrum

C₆H₇NO₂

No significant UV absorption above 220 nm

1³C NMR Spectrum (50.0 MHz, CDCl₃ solution)

DEPT CH₃ CH₃ CH

proton decoupled solvent

1¹H NMR Spectrum (200 MHz, CDCl₃ solution)

2H 2H 3H

δ (ppm)

Grade Ranges for Exam 5

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Random Notes

The exam average and standard deviation was 56.8 ± 22.9. The average as a percentage of total points was about 58.0%. The spectroscopy problem (#9) and synthesis (#11) were notably challenging, less than 50% of the points were awarded for these problems.