1. Would you expect the following reaction to occur (form product)? Why or why not?

\[
\text{O}_\text{Me} \quad + \quad \text{Cl}^- \quad \rightleftharpoons \quad \text{O}_\text{Cl} \quad + \quad \text{O}_\text{Me}^- \\
\]

2. Write a mechanism for the acid-catalyzed transesterification reaction of methyl acetate with ethanol.

3. Rank the following compounds (from 1-5) in order of decreasing reactivity in a nucleophilic acyl substitution reaction (1 = most reactive, 5 = least reactive).

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4. Show the major organic product for each of the reactions below:

MULTIPLE CHOICE (6 pts each)

5. Which of the following compounds is an amide?

(a) \( \text{CN} \)  (b) \( \text{NH}_2 \)  (c) \( \text{NH}_2 \)  (d) \( \text{NH}_2 \)

6. Which of the following compounds is an acyl chloride?

(a) \( \text{Cl} \)  (b) \( \text{Cl} \)  (c) \( \text{Cl} \)  (d) \( \text{Cl} \)
7. Which of the following compounds is an ester?

(a) \[\text{Ph} \text{CO} \text{CH}_3\] (b) \[\text{HO} \text{C} \text{CH}_3\] (c) \[\text{PhCO} \text{Ph}\] (d) \[\text{CO}_2\text{H}\]

8. What is the IUPAC name for the compound shown below?

\[\text{H}_3\text{C} \text{O} \text{C} \text{Ph}\]

(a) phenyl acetate  (c) benzyl acetate
(b) methyl benzoate  (d) methyl phenylacetate

9. Which of the following compounds is N,N-dimethylbenzamide?

(a) \[\text{Ph} \text{CO} \text{NHMe}\] (b) \[\text{NH}_2 \text{CO} \text{Ph}\] (c) \[\text{PhCO} \text{NMMe}_2\] (d) \[\text{Ph} \text{CONMe}_2\]

10. What is the hybridization of the carbonyl carbon in carboxylic acids and their derivatives?
(a) sp³  (b) sp  (c) sp²  (d) d

11. Acyl chlorides undergo nucleophilic substitution at a faster rate than esters because:
(a) Esters are more sterically hindered than acyl chlorides.
(b) Acyl chlorides are more sterically hindered than esters.
(c) A chloride ion is a better leaving group than an alkoxide ion.
(d) Esters hydrolyze faster than acyl chlorides.

12. Esters and amides are most easily made by nucleophilic acyl substitution reactions on:
(a) alcohols  (b) anhydrides  (c) acyl chlorides  (d) carboxylic acids
13. The hydrolysis of esters in base is called:
   (a) Fischer esterification
   (b) Dieckmann condensation
   (c) saponification
   (d) transesterification

14. Which of the following compounds has the lowest boiling point?
   (a) 1-butanol
   (b) butanoic acid
   (c) methyl propanoate
   (d) butanamide

**Bonus (+5 pts): Which compound would you expect to have a higher dipole moment: methyl acetate or butanone? Which would you expect to have a higher boiling point. Explain your answer.

\[ \text{methyl acetate} \]
\[ \text{butanone} \]