

1. (6) Write the LETTER corresponding to the correct name on the line next to each structure.

- |                          |       |  |       |   |
|--------------------------|-------|--|-------|---|
| A. acetic acid           | _____ | $\begin{array}{c} \text{OO} \\     \\ \text{HOCCOH} \end{array}$                     | _____ | $\begin{array}{c} \text{O} \\    \\ \text{HCOH} \end{array}$                                      |
| B. formic acid           | _____ | $\begin{array}{c} \text{O} \\    \\ \text{HCN}(\text{CH}_3)_2 \end{array}$           | _____ | $\begin{array}{c} \text{O} \quad \text{O} \\    \quad    \\ \text{HOCCH}_2\text{COH} \end{array}$ |
| C. ethyl formate         | _____ | $\begin{array}{c} \text{O} \\    \\ \text{CH}_3\text{COCH}_2\text{CH}_3 \end{array}$ | _____ | $\begin{array}{c} \text{O} \\    \\ \text{CH}_3\text{COH} \end{array}$                            |
| D. N,N-dimethylformamide |       |  |       |   |
| E. 2-oxopropanoic acid   |       |  |       |   |
| F. oxalic acid           |       |  |       |   |
| G. malonic acid          |       |  |       |   |
| H. none of the above     |       |  |       |   |

2. (2) Circle the most easily hydrolyzed derivative of carboxylic acids; underline the least reactive.

acid chloride      anhydride      ester      thioester      amide

3. (2) Circle the LETTER corresponding to the most acidic protons in each structure:

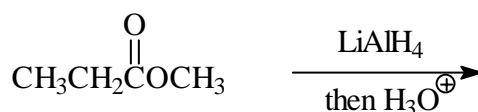
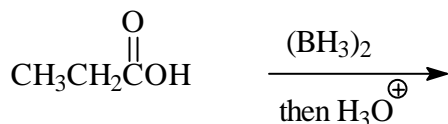
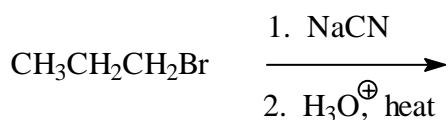


4. (3) Draw two resonance forms for the propanoate ion (the conjugate base of propanoic acid) and comment on the relative length of the two carbon-oxygen bonds.

5. (2) Circle the more acidic compound in each pair:

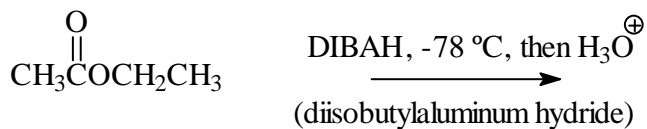
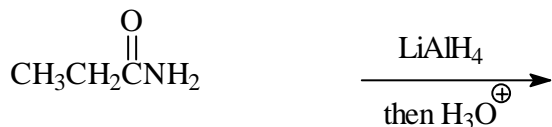
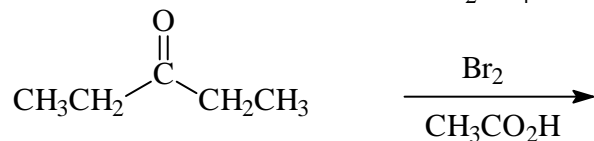
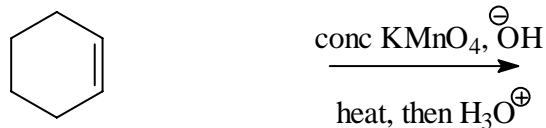
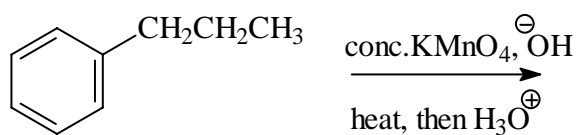
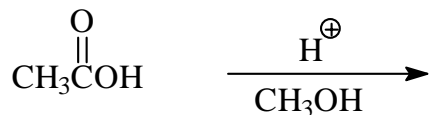


6. (30) Draw the structure of the major organic product(s) of each of the following. Where two organic products are formed in equal amounts, you must show both products.



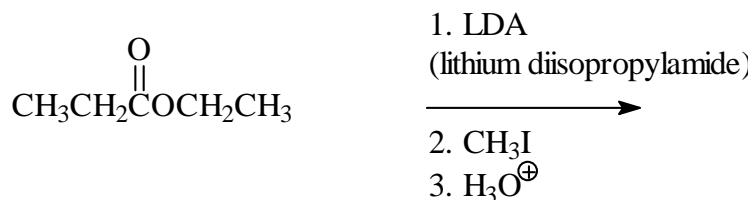
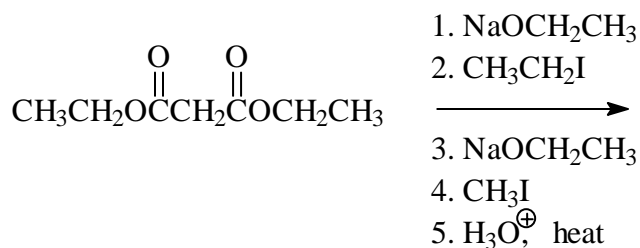
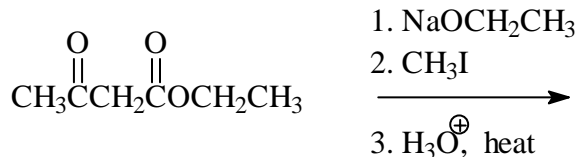
**Test 3**

6. (continued)

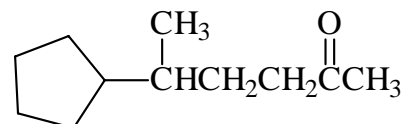
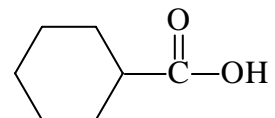


7. (2) Acid-catalyzed hydrolysis of any derivative of a carboxylic acid leads to the corresponding \_\_\_\_\_.

8. (6) Draw the structure of the major organic product of each of the following:



9. (4) Outline a step-by-step synthesis of each of the following, starting with either ethyl acetoacetate (acetoacetic ester) or diethyl malonate (malonic ester). Be sure to write the correct structure of the reactant ester and show all reagents and conditions needed for each step. You need NOT show intermediates. You may show a numbered sequence of steps above and below one arrow.



10. (3) Write the step-by-step mechanism for the reaction of methyl acetate with aqueous acid and heat (acid catalyzed hydrolysis of an ester). Be sure to show charges, arrows indicating electron flow and the structures of any intermediates and each product. (products are not shown, but YOU must draw their structures).

