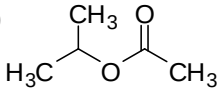
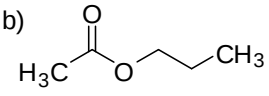
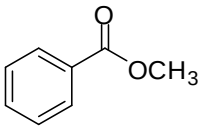
NOTE: NO ANSWERS WILL BE POSTED FOR THIS PROBLEM SET

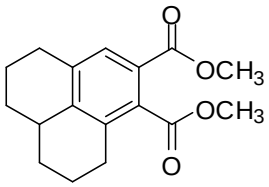
Saponification: Base-promoted hydrolysis

1. How much (in mL) 0.20 M NaOH is required to completely saponify 1 g of each of the following esters? Give the structures of the saponification products (after work-up).

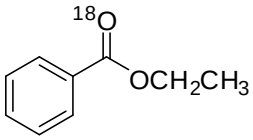
a) 

b) 

c) 

d) 

2. Ester hydrolysis is a very important biological reaction. Its mechanism was studied in detail using substrates that were isotopically labeled. Some important results were reported by M. L. Bender in 1950 (Northwestern University, Chicago, Illinois): the hydrolysis of ethyl benzoate labeled with ^{18}O as shown, in a mixture of un-labeled H_2O-NaOH was halted before the end of the reaction and the starting ester was isolated. Analysis of this ester showed that a considerable amount of the ^{18}O label had been lost (the carbonyl oxygen was now a normal ^{16}O). Write a mechanism for the saponification that shows an explanation of this result.

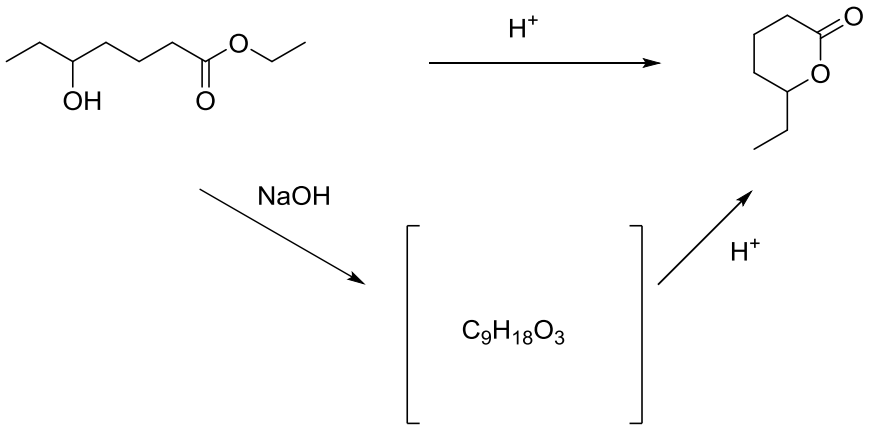


3. In an experiment to determine the molar mass of an ester, 500 mg of the ester were hydrolyzed with 50.00 mL of an alcoholic NaOH. The mixture after the reaction was complete required 15.00 mL of hydrochloric acid, 0.500 M, to be neutralized. When the concentration of the starting NaOH solution was determined, 20.00 mL of the same NaOH solution was neutralized with exactly 10.00 mL of 0.500 M hydrochloric acid. Calculate the molar mass of the ester and propose a structure.

Fats and detergents

1. What is the structure of
   a) palmitic acid
   b) stearic acid
   c) linoleic acid
   d) oleic acid

1. Explain the following transformations. What is the structure of **II** ?



2. Sodium alkylbenzene sulfonates were commonly used as detergents in the 50s. Why are they no longer commonly used?

3. Describe with an equation:
   a) The preparation of a hard soap from a natural fat
   b) The effect of hard water on soap
   c) The effect of sodium phosphate or carbonate on the detergency power of soap in hard water.