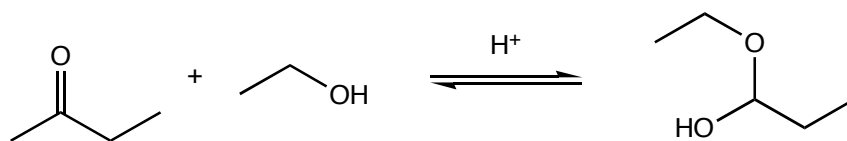
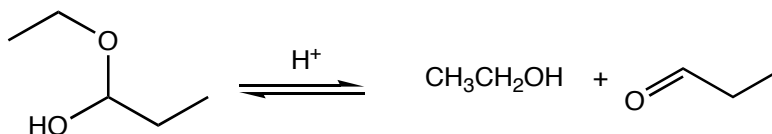


1. Acids catalyze nucleophilic additions of water and alcohols to carbonyls. (a. 4 pts.) Protonate the following ketone, and (b. 8 pts.) explain how the acid can increase the rate of the reactions.



2. (10 pts.) Hemiacetals are in equilibrium with carbonyls and the alcohols from which they are formed. Draw a mechanism for the conversion from hemiacetal to carbonyl.



3. (10 pts.) Hemiacetals can react with alcohols to make acetals. Draw the products and byproducts of the following reaction.

