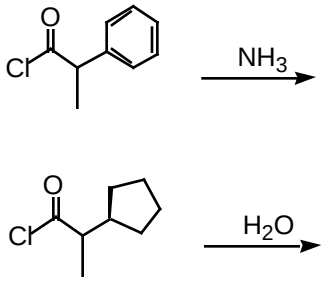
Chem 304B Spring, 1999. 3/25/99 Relevant Problems from previous year's final exams. [For review only]

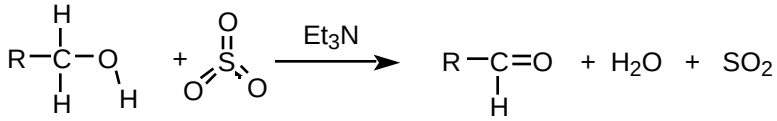
I. *For each of the following pairs of reactions, predict which will occur faster. Write the organic product(s) for the faster reaction and give the single most important reason for the difference (explain in detail).*

A. (6 pts)

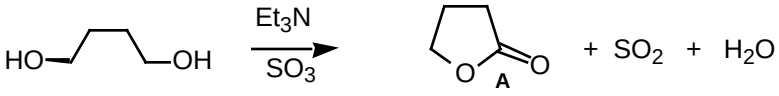


III. The oxidation of primary alcohols to aldehydes can be accomplished by numerous reagents.

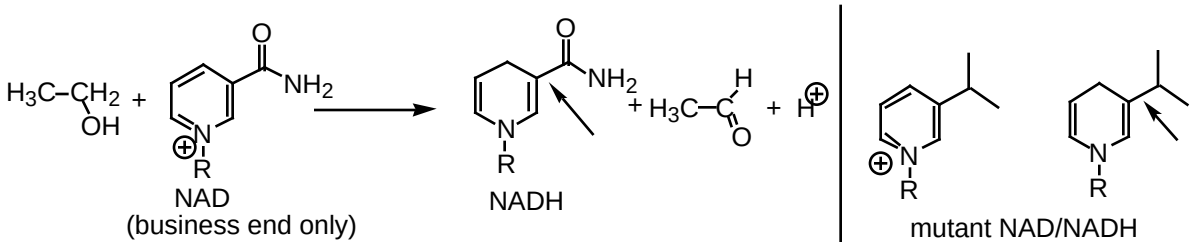
A. One reagent which is useful in producing aldehydes is SO_3. Addition of a weak base such as triethylamine accelerates the process. *Write a mechanism to show this conversion with the generic alcohol, R-CH_2-OH → R-CHO. Be sure your mechanism accounts for the products shown and the role of Et_3N.*



B. The di-alcohol, 1,4-dihydroxybutane, behaves strangely under comparable oxidation conditions, giving the cyclic ester (lactone), **A**, instead of the expected dialdehyde. *Please rationalize by writing the best mechanism for this process.*



VI. NAD is an acronym for Nature's oxidizing agent; it is a complicated molecule with a pyridinium ion as the reactive center. If one mixes ethyl alcohol with NAD at normal temperatures, the oxidation reaction is slow. However, in the presence of an enzyme, *alcohol dehydrogenase*, the mixture of NAD and ethyl alcohol rapidly produces acetaldehyde and NADH. A mutant cofactor, where the amide side chain is replaced by an isopropyl group, is much less effective, using the same enzyme.

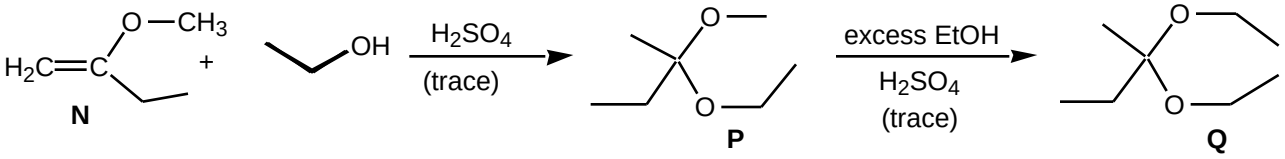


A. Consider the single bond indicated with the arrow in NADH. How would the barrier to rotation of this bond compare with the corresponding bond in "mutant NADH"? Explain carefully.

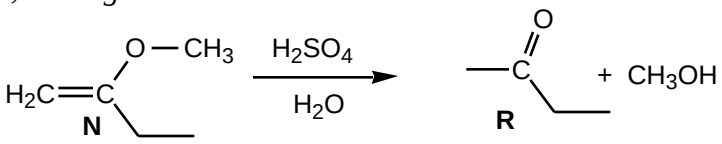
B. Leaving aside the role of the enzyme, how would you compare the intrinsic reactivity of the normal NAD with the mutant NAD in the oxidation process.

More reactive? Less reactive? No change? Explain your choice.

VII. A. The alkene **N** reacts with ethyl alcohol in the presence of a small amount of sulfuric acid to give **P**; if the reaction continues with excess ethyl alcohol a new product appears, **Q**. *Write a mechanism to explain these observations.* You need not show every proton transfer, but be sure you make clear the role of the sulfuric acid as a catalyst.



B. *Write a mechanism to account for the somewhat different result, when **N** is allowed to react with water containing sulfuric acid, leading to the ketone **R**.*

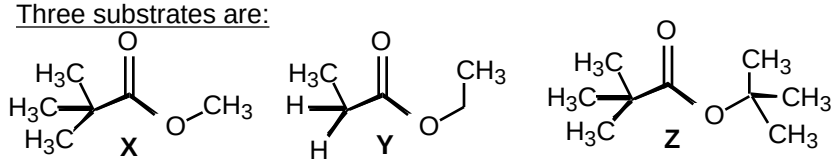


VIII. READ THE ENTIRE PROBLEM FIRST. There are at least four distinct mechanisms for ester hydrolysis, depending on the conditions and the structure of the substrates. The products are different for each mechanism. For a given mechanism, the rate is strongly dependent on the substrate structure.

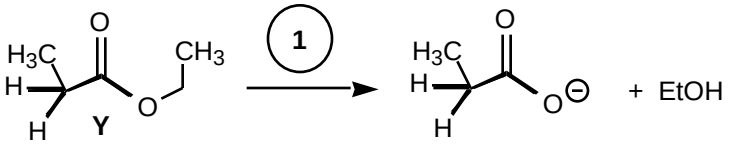
Four typical conditions are:

1. NaOH, H_2O or CH_3OH solvent
2. $CH_3S^{\ominus}$, CH_3OH solvent
3. H_2SO_4 (catalytic amt), ether solvent
4. H_2SO_4 (catalytic amt), H_2O solvent

Three substrates are:

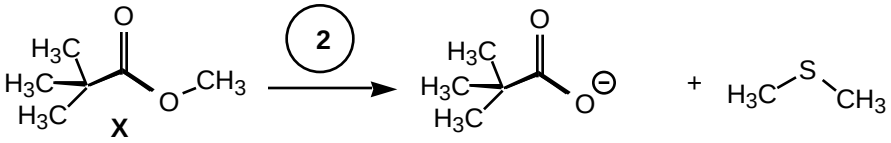


A. Using conditions **1**, compound **Y** reacts most rapidly compared to **X** and **Z**.



*Write the most reasonable mechanism for this process and explain why **Y** reacts faster than **X** and **Z** by this mechanism.*

B. Using conditions **2**, compound **X** reacts most rapidly compared to **Y** and **Z**.



*Write the most reasonable mechanism for this process and explain why **X** reacts faster than **Y** and **Z** by this mechanism.*