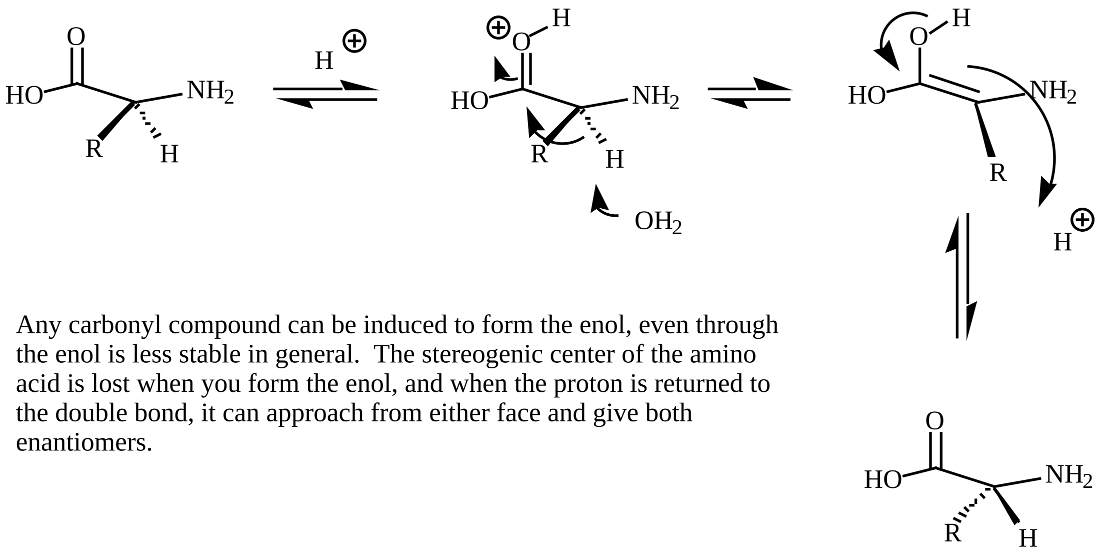
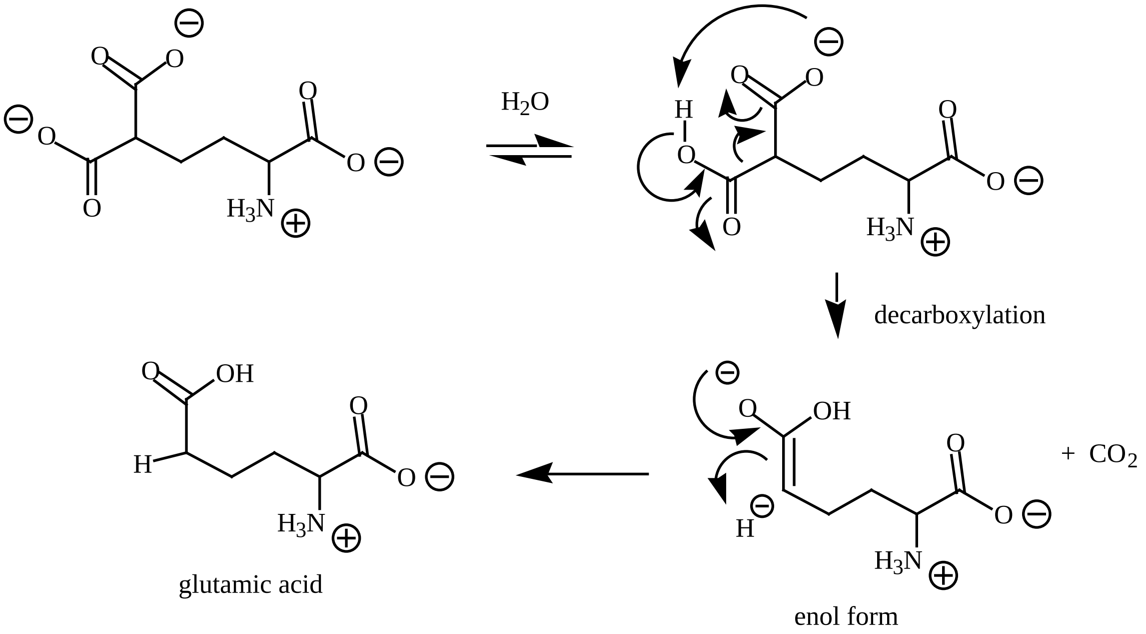
Chemistry 304B **KEY TO** Problem Set 10

1. Amino acids [and peptide units in proteins] can racemize in the presence of acid. Explain with a mechanism.
   Begin by drawing the structure of phenyl alanine and use this for your example



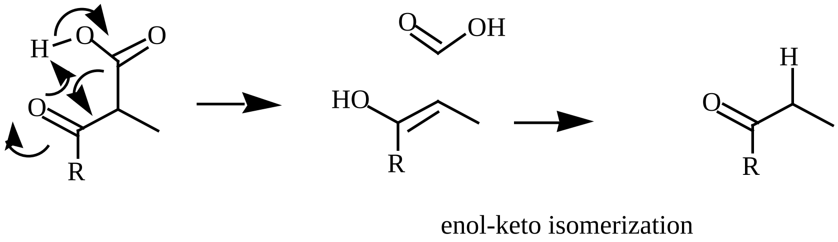
Any carbonyl compound can be induced to form the enol, even through the enol is less stable in general. The stereogenic center of the amino acid is lost when you form the enol, and when the proton is returned to the double bond, it can approach from either face and give both enantiomers.

2. An unusual amino acid, **1**, eluded detection until 1974. Explain why this molecule might be difficult to isolate.

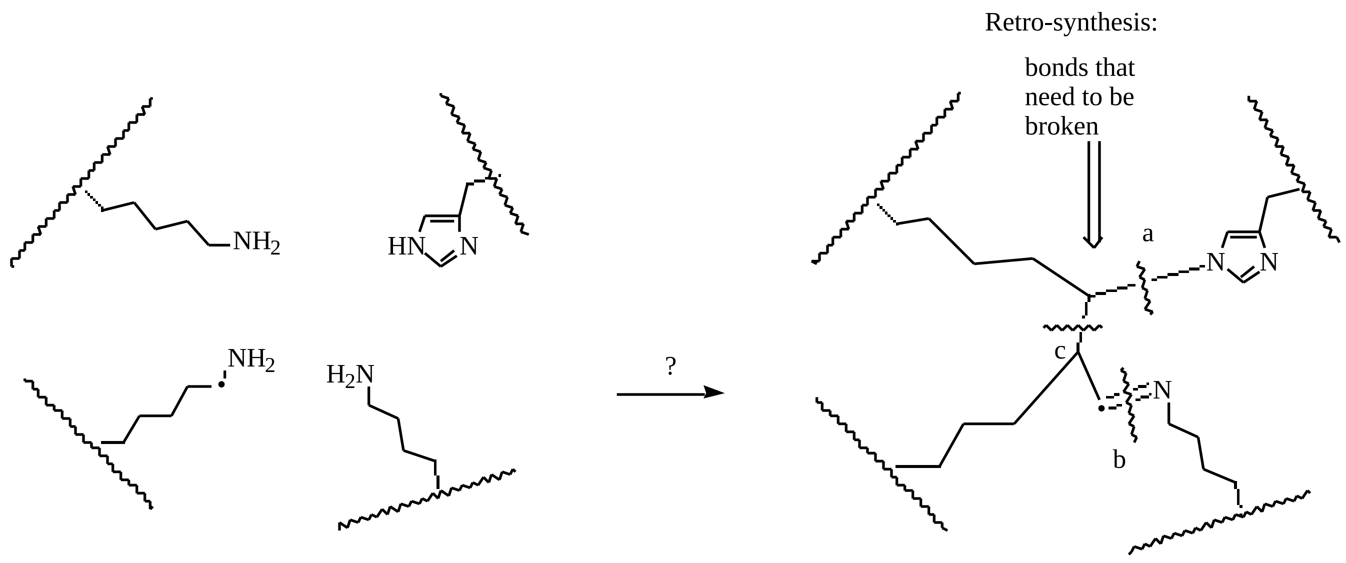


The starting amino acid is unstable with respect to decarboxylation because it has a CO_2H group β to a carbonyl group (another CO_2H in this case)

Recall the general mechanism for decarboxylation of β-ketoacids:

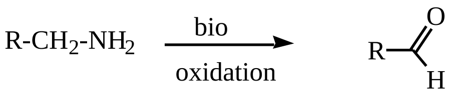


3. The structural protein collagen is made more rigid by "cross-linking" of the side chains of some basic amino acids through some functional group conversions. Lysine amino groups can be oxidized to aldehyde units, as shown in a simple case below (no mechanism shown; don't worry about that now). The cross-linking takes place following two oxidations. Write the pathway leading to the cross-linked product on the right. HINT: among other processes, you should find an aldol reaction and a 1,4-addition of a nucleophile. Identify these carefully in your mechanism.

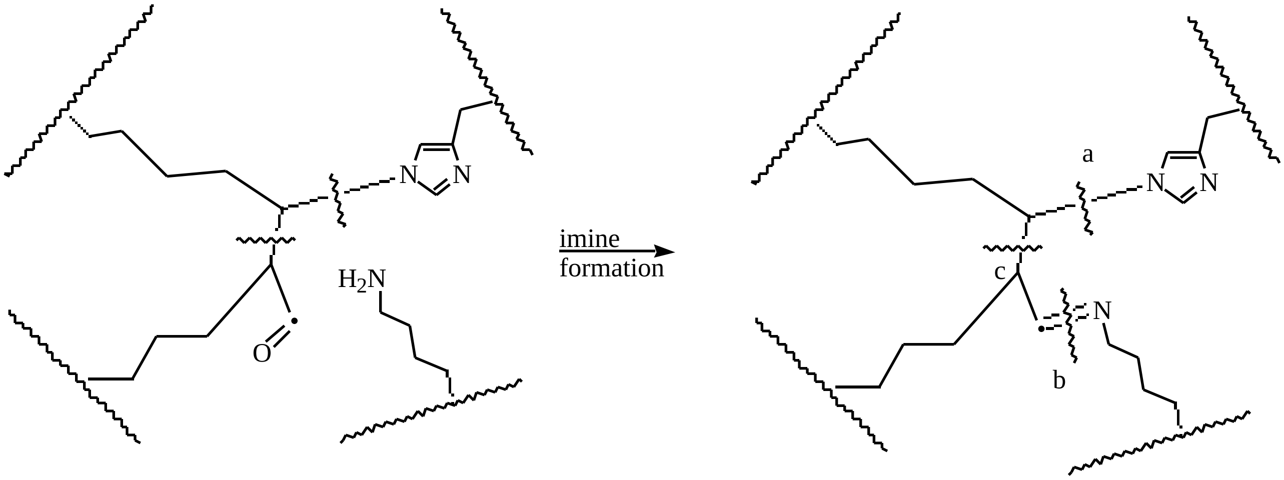


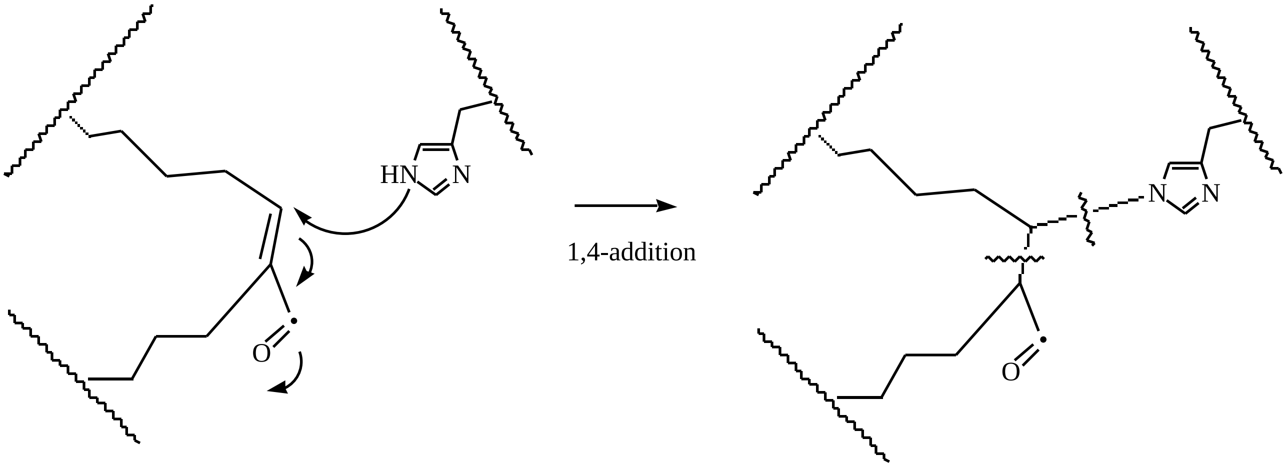
4 polypeptide chains in the collagen structure

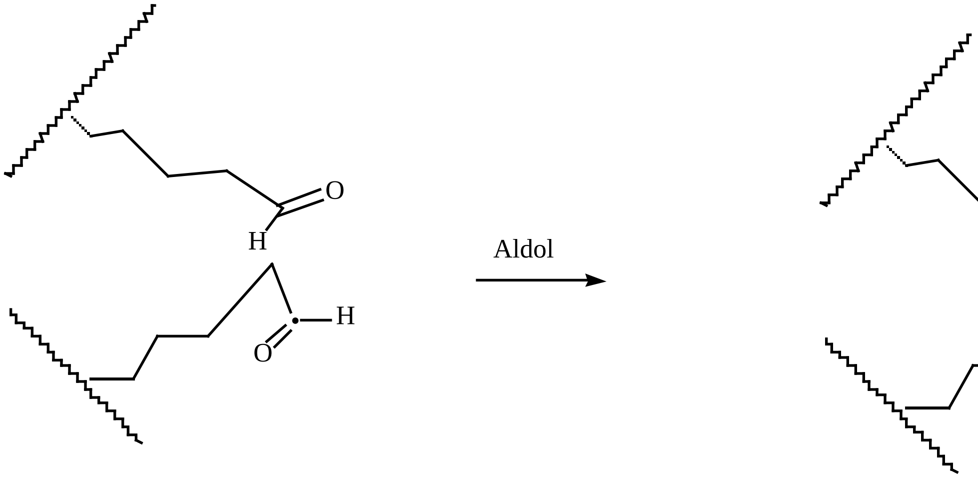
crosslinked collagen



It is probably important here to work backwards as well as forward. Think about the bonds that have to be formed and the typical mechanisms we have available to form them. The bond (a) to the imidazole unit looks like nucleophile nitrogen adding to some electrophile: S_N2, 1,2-addition, 1,4-addition. The imine is quite clearly formed (b) from amine addition to an aldehyde, eliminating water. The bond (c) is then adjacent to a C=O, a potential enol or enolate for aldol type reaction. There are a number of combinations or sequences which can work, but one of them is as follows:







Obviously, the two amino groups have to be converted to aldehydes by the oxidation mechanism specified.