Mapping an Active Site

These questions are based upon the two-page diagram on the "Catalytic Triad of the Serine Proteases." You'll need to have that available in color and study it carefully. Focus on where bonds are made and broken.

The catalytic triad (shown in blue) is a group of amino acid residues that serve to help remove the H from the OH (shown in red) in ser as the reaction proceeds.

1. Identify the substrate in this reaction (circle it).
2. Mark the amino terminus of the substrate. Mark any α carbons visible in the substrate.
3. Which amino acid residues are involved in substrate binding?

} see diagram

4. Which amino acid residues are involved in catalysis?

5. Describe the reaction carried out in this sequence (a simple name is desirable). Remember that the enzyme is 'unchanged.' With this in mind, try to write out a more or less balanced reaction for what's going on here, using descriptive names rather than structures or formulas. The overall reaction should become apparent.

It's hydrolysis (breaking w/ H_2O)

$AA_n + H_2O \longrightarrow AA_x + AA_y$ where $x+y=n$

6. In a site-directed mutagenesis experiment, individual amino acids can be changed. To which amino acid could you change the ser and expect relatively little change? What if you changed the ser to ala? Will this make the reaction go faster or slower? Explain.

ser → cys would be an acceptable change
ser → ala would kill the enzyme (no more OH)

7. Assuming all side chains have pK_a's with their usual values, at what pH range do you think this reaction will occur? Explain.

his needs to cycle between protonated + deprotonated forms, so roughly pH 6 where 50% is protonated. However, it gets its proton from ser, so it needs to start out deprotonated

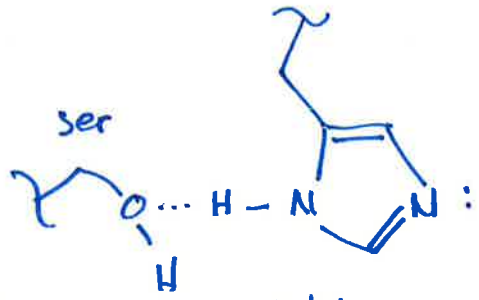
8. On the second ~~diagram~~ panel in the sequence, what is the additional structure at the end of the double-headed arrow?

It's a resonance form

9. Will the reaction diagrammed here proceed is the asp is changed to ala? To ser? Explain your prediction in each case.

probably much slower, since asp can no longer assist his in catalysis

ser isn't charged so won't stabilize his^+ as well, but it can hydrogen-bond. So, somewhat slower



ser can assist his but not as well as asp can

KEY

Chemistry 240
Professor Hanson

The Catalytic Triad of the Serine Proteases