1. a. lyase
   b. lyase
   c. transferase

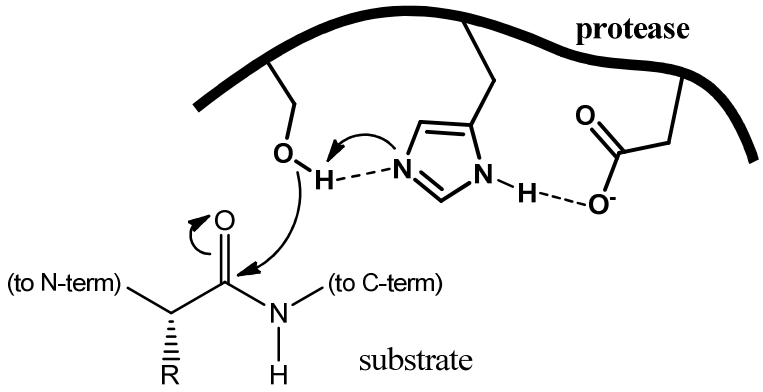
2. a. False; the largest free energy *difference* between an intermediate (or reactant) and the following transition state determines the rate of the reaction.
   b. False; *glutamate* acts as the general base, deprotonating water
   c. False; preferential binding generally involves weak interactions
   d. True, although the reaction will go in the reverse direction
   e. True
   f. False; although this is sometimes true, it may be the difference in free energy between an *intermediate* and the following transition state
   g. False; the activation energy determines the rate of the reaction; the ΔG determines the direction
   h. False; although they are often connected (if there is preferential binding of an intermediate, there is also preferential binding of a TS), they refer to different states of the reacting molecule

3. 1. F (kinase) and T (transferase)
   2. C (dehydrogenase) and M (oxidoreductase)
   3. J (lyase) and R (synthase)

4. The stabilization, through weak interactions with the enzyme, of a transition state *beyond* that of the bound substrate. This binding is important to enzyme catalysis because the transition state energy must be lowered for the rate of the reaction to increase. Binding the substrate too well prevents its conversion to product; the enzyme must favor binding of a transition state over binding of the substrate.

5. a. lysozyme
   b. peptidoglycan; bacterial cell wall structure
   c. hydrolase
   d. (1) proximity and orientation effects
      (2) covalent catalysis
          general acid catalysis
          preferential binding of TS
      (3) proximity and orientation effects
      (4) general base catalysis

6.



7. a. Unaffected (or minimally affected). Asparagine is similar in size, shape, and polarity (H-bonding) to aspartate, so the active site won't change much. (Also, the substrate doesn't directly contact this amino acid.)
   b. Disrupted (or greatly diminished). Although asparagine could H-bond to histidine, without aspartate's negative charge, histidine's pKa would not rise enough on substrate binding to significantly deprotonate serine and promote catalysis

8. The oxyanion hole is a gap in the active site of serine proteases, into which the oxyanion of the tetrahedral intermediates of catalysis move; here the oxyanion is stabilized through hydrogen bonding with two backbone N-H groups.

9. In both divergent and convergent evolution, two molecules share common structural features. In divergent evolution, these features are shared because of common ancestry, whereas in convergent evolution, these features arose independently.