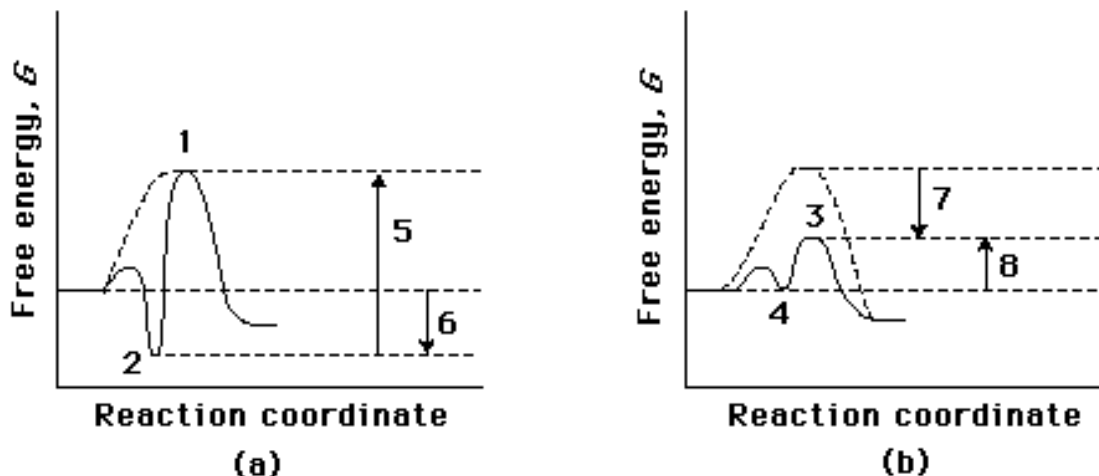
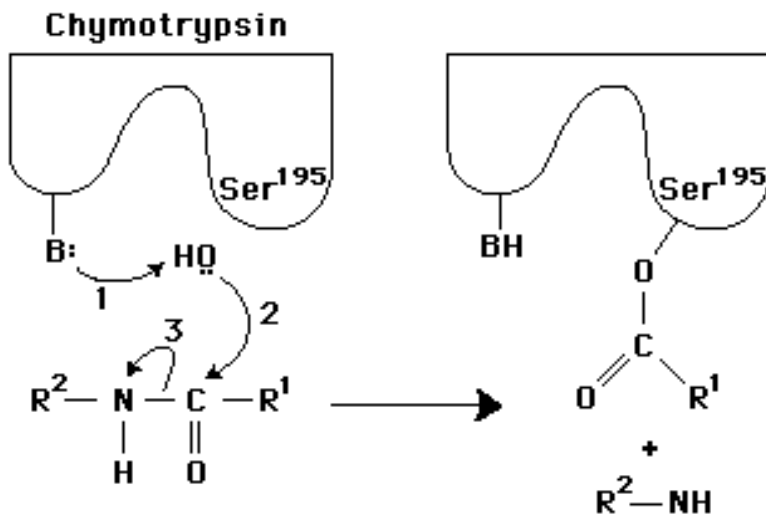


MCB 102 Wk 5 Practice Problems: ANSWER KEY
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1. Compare the two reaction coordinate diagrams below and select the answer that correctly describes their relationship. In each case, the single intermediate is the ES complex. (A)



- A) (a) describes a strict “lock and key” model, whereas (b) describes a transition-state complementarity model.
- B) The activation energy for the *catalyzed* reaction is #5 in (a) and is #7 in (b).
- C) The activation energy for the *uncatalyzed* reaction is given by #5 + #6 in (a) and by #7 + #4 in (b).
- D) The contribution of binding energy is given by #5 in (a) and by #7 in (b).
- E) The ES complex is given by #2 in (a) and #3 in (b).



2. In the above diagram of the first phase in the reaction catalyzed by the protease chymotrypsin, which step illustrates the process of general base catalysis and which illustrates the process of covalent catalysis?

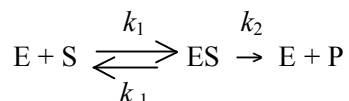
Ans: The first step (arrow labeled 1) generates illustrates base catalysis through the generation of a nucleophilic ion that attacks the peptide carbonyl group (arrow 2), which

illustrates covalent catalysis.

3. The benefit of measuring the *initial* rate of a reaction V_0 is that at the beginning of a reaction: (B)

- A) [ES] can be measured accurately.
- B) changes in [S] are negligible, so [S] can be treated as a constant.
- C) changes in K_m are negligible, so K_m can be treated as a constant.
- D) $V_0 = V_{\max}$.
- E) varying [S] has no effect on V_0 .

4. Michaelis and Menten assumed that the overall reaction for an enzyme-catalyzed reaction could be written as



Using this reaction, the rate of breakdown of the enzyme-substrate complex can be described by the expression: (D)

- A) $k_1 ([E_t] - [ES])$.
- B) $k_1 ([E_t] - [ES])[S]$.
- C) $k_2 [ES]$.
- D) $k_{-1} [ES] + k_2 [ES]$.
- E) $k_{-1} [ES]$.

5. The steady state assumption, as applied to enzyme kinetics, implies: ©

- A) $K_m = K_s$.
- B) the enzyme is regulated.
- C) the ES complex is formed and broken down at equivalent rates.
- D) the K_m is equivalent to the cellular substrate concentration.
- E) the maximum velocity occurs when the enzyme is saturated.

6. The Lineweaver-Burk plot is used to: (D)

- A) determine the equilibrium constant for an enzymatic reaction.
- B) extrapolate for the value of reaction rate at infinite enzyme concentration.
- C) illustrate the effect of temperature on an enzymatic reaction.
- D) solve, graphically, for the rate of an enzymatic reaction at infinite substrate concentration.
- E) solve, graphically, for the ratio of products to reactants for any starting substrate concentration.

7. In a plot of $1/V$ against $1/[S]$ for an enzyme-catalyzed reaction, the presence of a competitive inhibitor will alter the: (B)

- A) curvature of the plot.
- B) intercept on the $1/[S]$ axis.
- C) intercept on the $1/V$ axis.
- D) pK of the plot.
- E) V_{\max} .

8. Which of the following statements about allosteric control of enzymatic activity is *false*?

(E)

- A) Allosteric effectors give rise to sigmoidal V_0 vs. $[S]$ kinetic plots.
- B) Allosteric proteins are generally composed of several subunits.
- C) An effector may either inhibit or activate an enzyme.
- D) Binding of the effector changes the conformation of the enzyme molecule.
- E) Heterotropic allosteric effectors compete with substrate for binding sites.

9. An enzyme catalyzes a reaction at a velocity of 20 $\mu\text{mol}/\text{min}$ when the concentration of substrate (S) is 0.01 M. The K_m for this substrate is 1×10^{-5} M. Assuming that Michaelis-Menten kinetics are followed, what will the reaction velocity be when the concentration of S is (a) 1×10^{-5} M and (b) 1×10^{-6} M?

Ans: The velocity of 20 $\mu\text{mol}/\text{min}$ is essentially V_{max} because it is measured at $[S] \gg K_m$. (a) When $[S] = 10^{-5}$ M = K_m , $V = 1/2 V_{\text{max}}$, or 10 $\mu\text{mol}/\text{min}$. (b) When $[S]$ is 10^{-6} M, velocity can be calculated from the Michaelis-Menten equation:

$$V_0 = V_{\text{max}} [S] / (K_m + [S]) = (20 \mu\text{mol}/\text{min})(10^{-6} \text{ M}) / (10^{-5} + 10^{-6}) = 1.8 \mu\text{mol}/\text{min}.$$