

CHEM 3410: Physical Chemistry I — Fall 2008

November 26, 2008

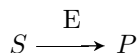
Lecture 36: Enzyme kinetics

References

1. Levine, *Physical Chemistry*, Chapter 16

Key Concepts

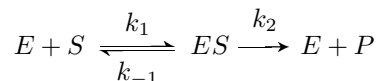
- Enzyme kinetics are a special application of catalysis.



where S is the substrate (reactant) and P is the product(s).

Enzymes are unique because they catalyze very specific reactions. Examples included the inversion of sucrose and the decomposition of lactose into glucose and galactose.

- Michaelis & Menton modeled the kinetics of enzyme action through the following mechanism:



- The rate of product formation for this mechanism is:

$$\frac{d[P]}{dT} = k_2[ES]$$

where ES is the intermediate enzyme-substrate complex. We need to eliminate this from the expression by using the steady-state approximation. This assumes that the rate of ES formation is slow compared to the rate at which is used up ($k_2 \gg k_1$)

$$\frac{d[ES]}{dt} = k_1[E][S] - k_{-1}[ES] - k_2[ES] = 0$$

- It is often difficult to know the enzyme concentration $[E]$. so M-M rewrote this as:

$$[E]_o = [E] + [ES]$$

where $[E]_o$ is the total amount of enzyme, which is either “free” ($[E]$) or bound to the substrate ($[ES]$).

- Making those substitutions and solving for $[ES]_{ss}$ we can get a rate expression that does not contain the intermediate:

$$\frac{d[P]}{dT} = k_2[ES] = \frac{k_1 k_2 [E]_o [S]}{k_1 [S] + (k_{-1} + k_2)} = \frac{k_2 [E]_o [S]}{[S] + K_m}$$

where $K_m = \frac{k_{-1} + k_2}{k_1}$, which is the Michaelis constant. This constant describes the ratio of how fast ES is getting used up to the rate at which ES is formed. k_2 is rate at which ES goes to the product(s). These are the two important kinetic parameters for this mechanism.