

This equation has no explicit (exact) solution. The following is an approximate solution known as the steady-state approximation that is valid for most of the time course of the reaction

This equation means that the $[ES]$ is approximately constant throughout most of the time of the reaction excluding a very short initial time as shown in Fig 10.17.

The rate equation for $[ES]$ can then be solved algebraically for $[ES]$ as follows

The velocity can now be expressed in terms of the rate constants, the $[S]$ and the $[E]_T$ as follows

The equation can be simplified as follows

The velocity can further be expressed in terms of the maximum velocity (V_{\max}) that occurs when all of the E is in the form of an ES complex

This last equation is known as the Michaelis-Menten equation.

Let's show that the M-M equation is consistent with the observed rates.

First consider v at 'low' $[S]$, i.e., when the $[S] \ll K_M$ as follows

Second consider v at "high" $[S]$, i.e., when the $[S] \gg K_M$ as follows

A kinetic analysis provides important information about the mechanism of an enzyme-catalyzed reaction.

The kinetic scheme for example indicates that the substrate must form a complex with the enzyme before it can be converted to products and that complex formation is reversible.

Consider further the possible significance of K_M .

If $k_{-1} \gg k_{\text{cat}}$, then $K_M = k_{-1}/k_1$

$k_{-1}/k_1 = K_S$, the dissociation constant for the ES complex

In this case, K_M is a measure of the affinity of the enzyme for the substrate.

The larger the value of K_M , the smaller is the affinity of the enzyme for substrate (because K_S is a dissociation constant).

The smaller the value of K_M , the larger is the affinity of the enzyme for the substrate.