Question 2: Enzyme Kinetics

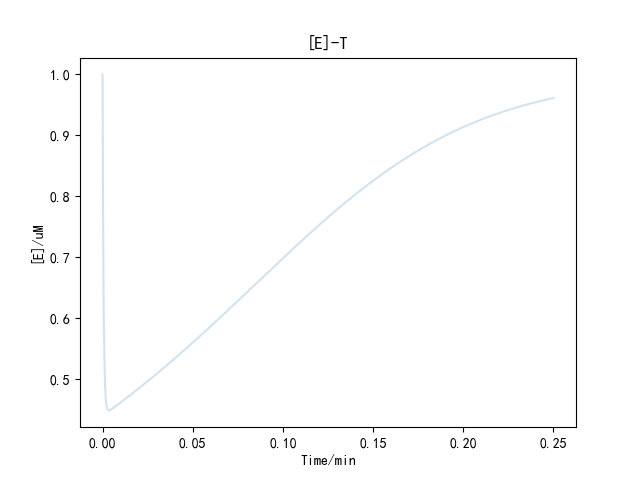
1.

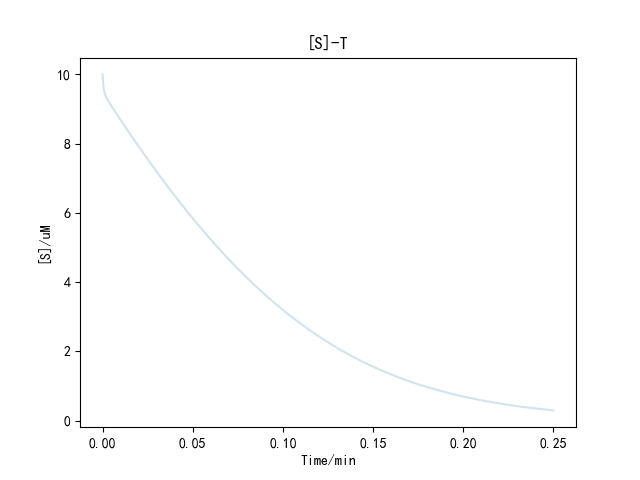
By using the law of mass action, we can get four equations for the rate of changes of the four species:

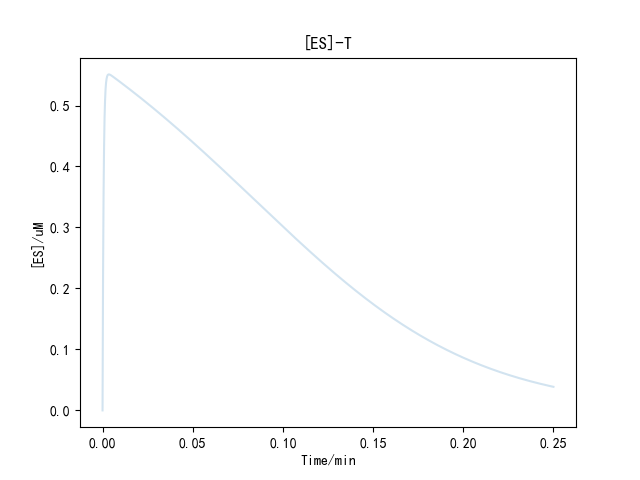
where represents the concentration of E, S, ES and P respectively.

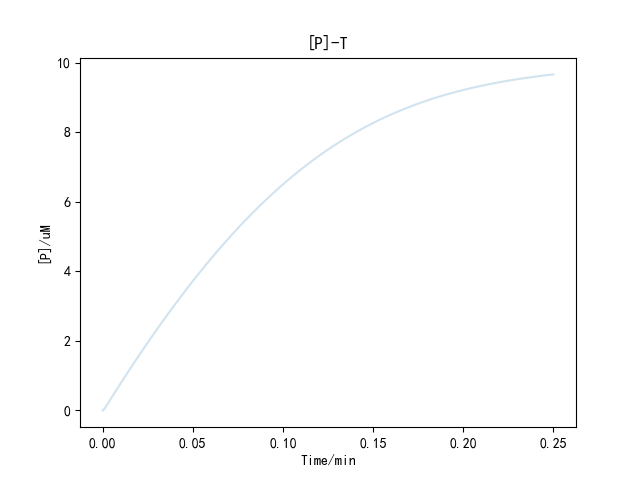
2.

Under given initial conditions, we can use fourth-order Runge-Kutta method to solve the above ordinary differential equation system. The numerical solution results of the ordinary differential equation system are as follows:



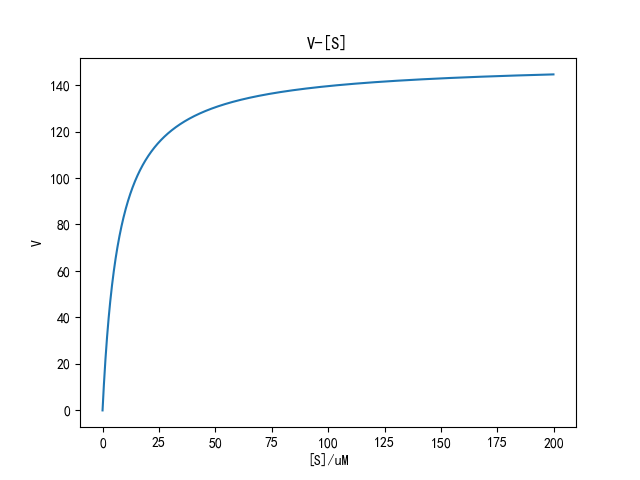






3.

Plot the velocity V as a function of the concentration of the substrate S:



From the figure, we can find that when the concentrations of S are very small, the velocity V increases approximately linearly. However, when the concentrations of S are large, the velocity V saturates to the maximum value .

We can also solve by theoretical derivation.

According to the steady state approximation:

Assume that the initial concentration of E is :

So, we can draw the same conclusion when the concentrations of S are large, the velocity V saturates to the maximum value .