8. Enzyme Kinetics

8.1.

The model given here is a simple one of enzyme kinetics, called the Michaelis-Menten Model, with the assumption that almost none of the product *P* reverts to the initial substrate.

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \overset{k_3}{\rightarrow} E + P$$

Using the law of mass action, gives a system of four differential equations that define the rate of changes of reactants with time *t*.

$$\frac{d[E]}{dt} = (k_2 + k_3)[ES] - k_1[E][S]$$

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

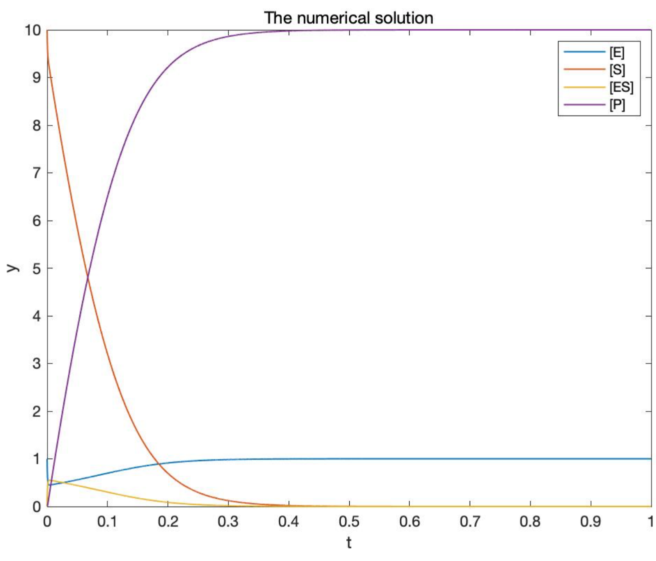
$$\frac{d[ES]}{dt} = k_1[E][S] - (k_2 + k_3)[ES]$$

$$\frac{d[P]}{dt} = k_3[ES]$$

[E], *[S]*, *[ES]*, and *[P]* represent the concentration of *E, S, ES,* and *P*, separately.

8.2.

Here is a plot of the numerical solution of the above four differential equations. The source code put in the file named 'question8.m'.



8.3.

The velocity, V, of the enzymatic reaction is the rate of change of the product P.

That means:

$$V = k_3[ES]$$

Plot the V as a function of the concentration of the substrate S, we can get the following figure, marked the maximum value of V. The source code is in the file named ‘question8.m’.