Question 2

8.1. Using the law of mass action, write down four equations for the rate of changes of the four species, E, S, ES, and P.

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

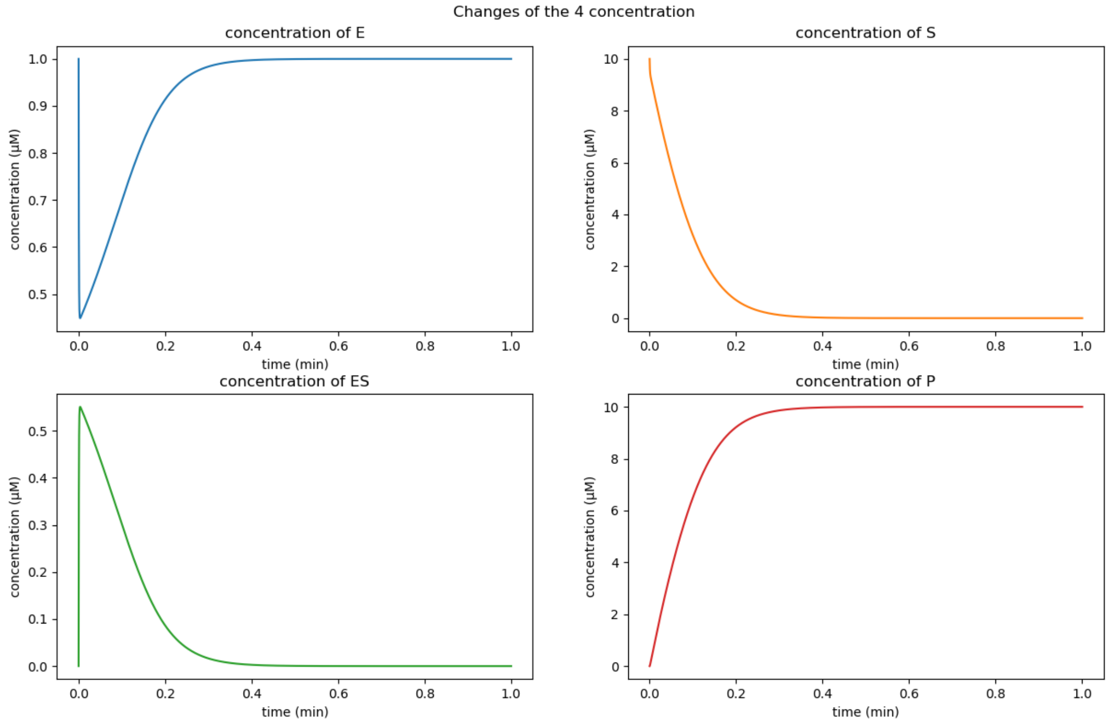
$$\frac{d[S]}{dt} = k_2[ES] - k_1[E][S]$$

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

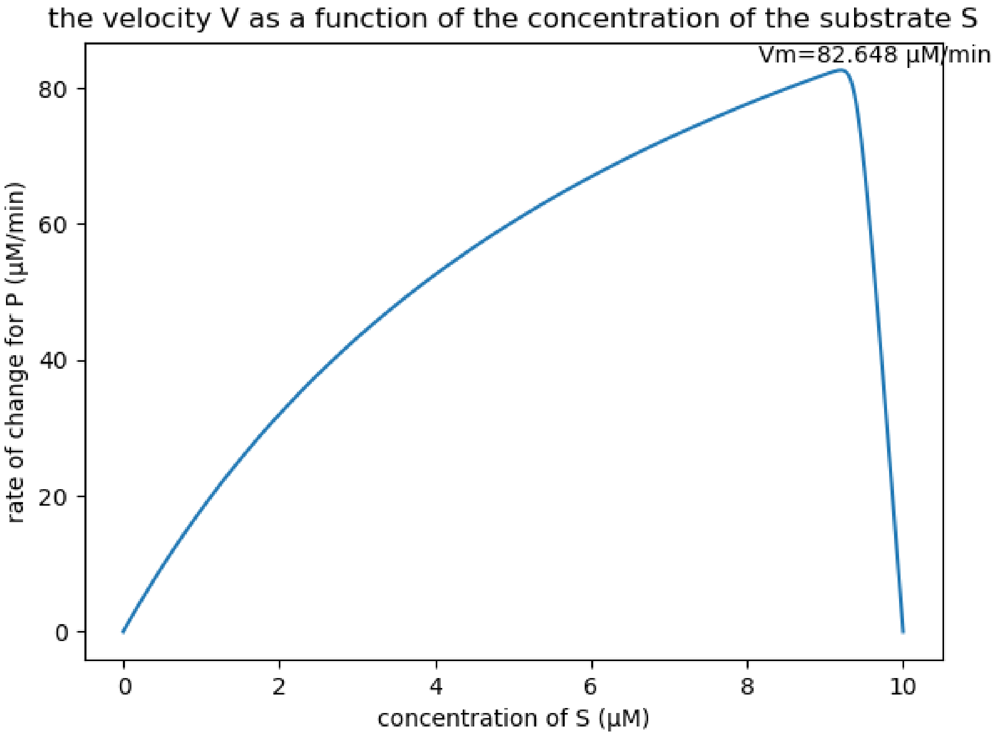
$$\frac{d[P]}{dt} = k_3[ES]$$

8.2. Write a code to numerically solve these four equations using the fourth-order Runge-Kutta method. For this exercise, assume that the initial concentration of E is 1 µM, the initial concentration of S is 10 µM, and the initial concentrations of ES and P are both 0. The rate constants are: k1=100/µM/min, k2=600/min, k3=150/min.

[code in the file 'rate.py']



8.3. We define the velocity, V, of the enzymatic reaction to be the rate of change of the product P. Plot the velocity V as a function of the concentration of the substrate S. You should find that, when the concentrations of S are small, the velocity V increases approximately linearly. At large concentrations of S, however, the velocity V saturates to a maximum value, Vm. Find this value Vm from your plot.



Vm is 82.648 µM/min