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*.

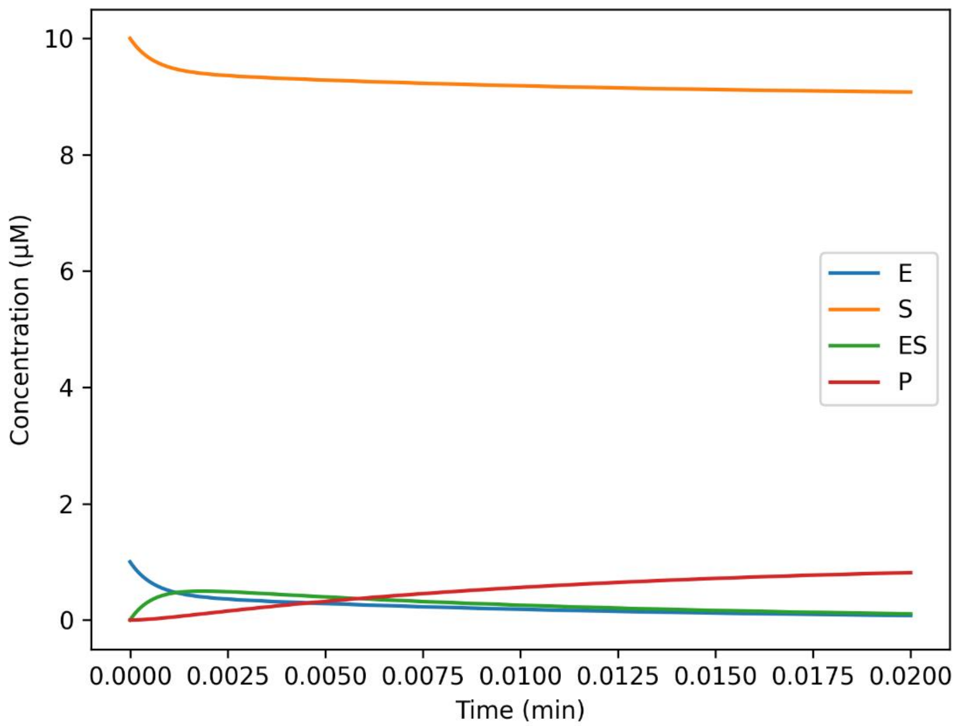
$$\frac{dE}{dt} = -k_1 C_E C_S + k_2 C_{ES} + k_3 C_{ES}$$

$$\frac{dS}{dt} = -k_1 C_E C_S + k_2 C_{ES}$$

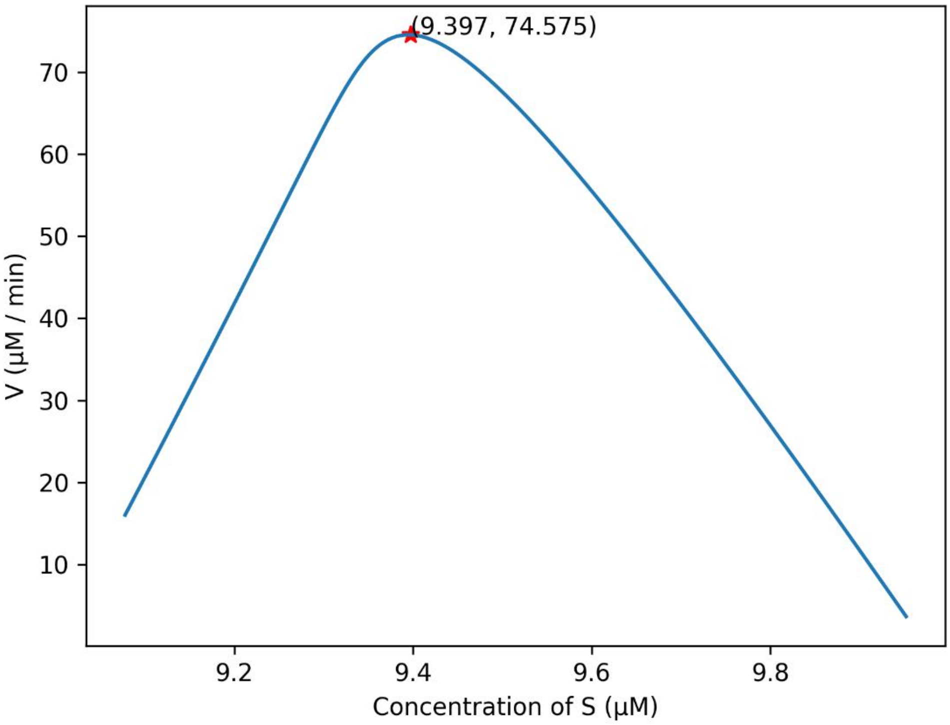
$$\frac{dES}{dt} = -k_1 C_E C_S - k_2 C_{ES} - k_3 C_{ES}$$

$$\frac{dP}{dt} = k_3 C_{ES}$$

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.



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.



(9.397, 74.575)
70
60
50
40
30
20
10
V (µM / min)
9.2
9.4
9.6
9.8
Concentration of S (µM)