8.1

According to the law of mass action and Michaelis-Menten kinetics, we can get the following equation:

$$Rate\ of\ change\ of\ ES = k_1[E][S] - k_2[ES] - k_3[ES]$$

$$Rate\ of\ change\ of\ S = -k_1[E][S] + k_2[ES]$$

$$Rate\ of\ change\ of\ E = -k_1[E][S] + k_2[ES] + k_3[ES]$$

$$Rate\ of\ change\ of\ P = k_3[ES]$$

Then we can get the following equation:

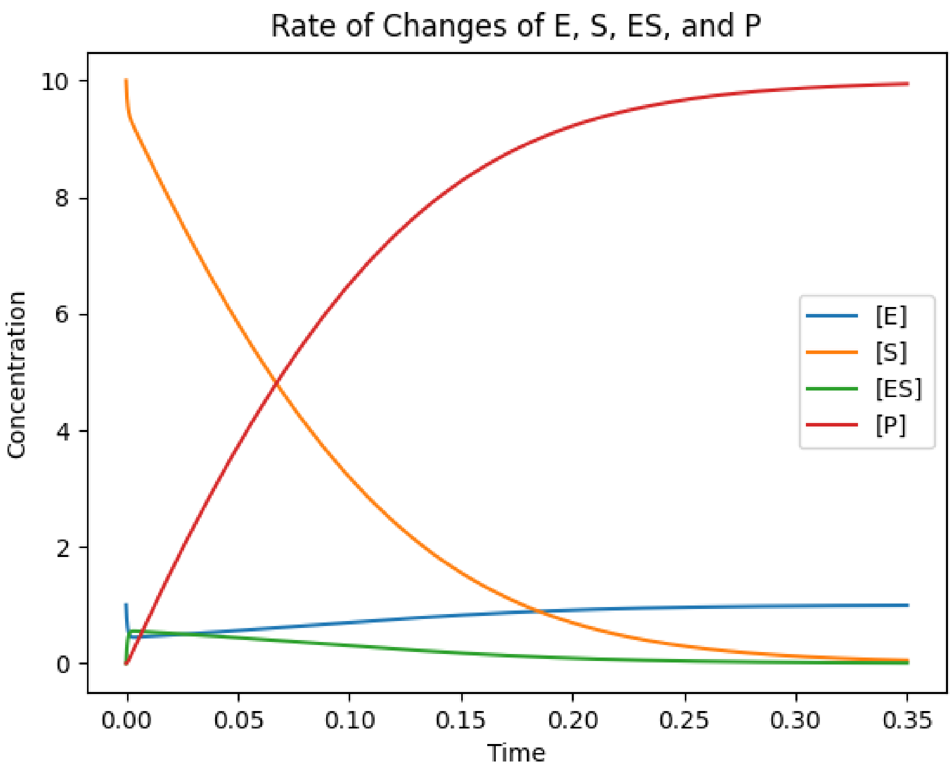
$$\frac{d[ES]}{dt} = k_1[E][S] - (k_2 + k_3)[ES]$$

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

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

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

8.2 The plot is shown below:



8.3

$$V = Rate\ of\ change\ of\ P = k_3[ES] = 150 * [ES]$$

According to the Michaelis-Menten equation, we have:

$$v = \frac{V_{max}[S]}{K_m + [S]}$$

When $[S] = K_m$, we have:

$$v = \frac{V_{max}}{2}$$

which the value of Km is half of Vmax

According to the calculation by python, the result shows $V_{max} = 82.665577902835$

The plot is shown below: