Question 2: Enzyme Kinetics

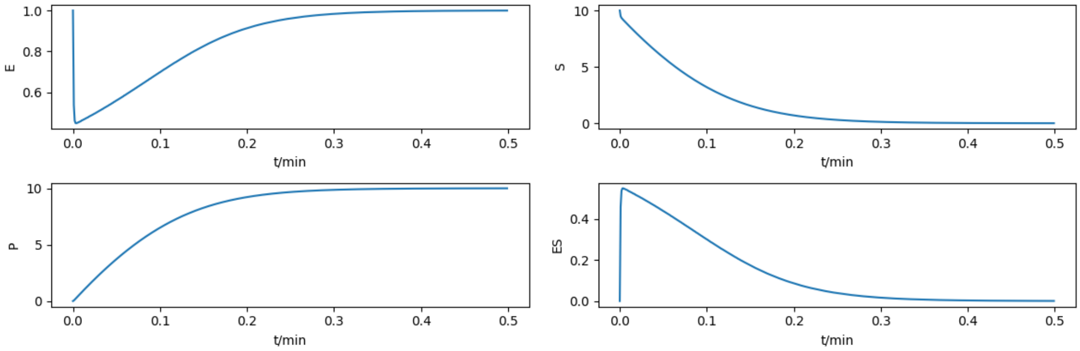
8.1

V(E) =K2 [ES]+K3 [ES]-K1 [E] [S]
V(S) =K2 [ES]-K1 [E] [S]
V(P) =K3 [ES]
V(ES)=K1 [E] [S]-K2 [ES]-K3 [ES]

8.2

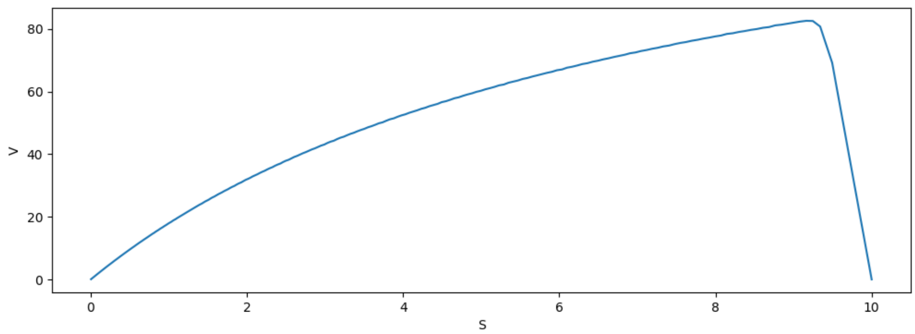
```
import numpy as np
import matplotlib.pyplot as plt
from scipy.integrate import solve_ivp

# set the initial paramters
k1=100
k2=600
k3=150
E0=1
S0=10
#V = [E,S,ES,P]^T    variable set
F = lambda t, V: np.array([-k1*V[0]*V[1]+(k2+k3)*V[2],-k1*V[0]*V[1]+k2*V[2],k1*V[0]*V[1]-(k2+k3)*V[2],k3*V[2]]) # ODEs

t_eval = np.arange(0, 0.5, 0.001) # t span
sol = solve_ivp(F, [0, 0.5], [E0, S0, 0, 0], t_eval=t_eval) # solve the ODE by fourth RK method, it is defaulted in solve_ivp func

# plot the concentration of the four species vs. time
plt.figure(figsize = (12, 4))
plt.subplot(221)
plt.plot(sol.t, sol.y[0])
plt.xlabel('t/min')
plt.ylabel('E')
plt.subplot(222)
plt.plot(sol.t, sol.y[1])
plt.xlabel('t/min')
plt.ylabel('S')
plt.subplot(223)
plt.plot(sol.t, sol.y[3])
plt.xlabel('t/min')
plt.ylabel('P')
plt.subplot(224)
plt.plot(sol.t, sol.y[2])
plt.xlabel('t/min')
```

```
plt.ylabel('ES')
plt.tight_layout()
plt.show()
```



8.3

```
# plot the velocity of P vs. the concentration of S
plt.figure(figsize = (12, 4))
plt.plot(sol.y[1],k3*sol.y[2])
plt.xlabel('S')
plt.ylabel('V')
plt.show()
```



The V_m is approximately 82μM/min.