Q2:

8.1:

[A] :the concentration of A
The rate of change of E:

$$\frac{d[E]}{dt} = (k_2 + K_3)[ES] - k_1[E][S]$$

The rate of change of S:

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

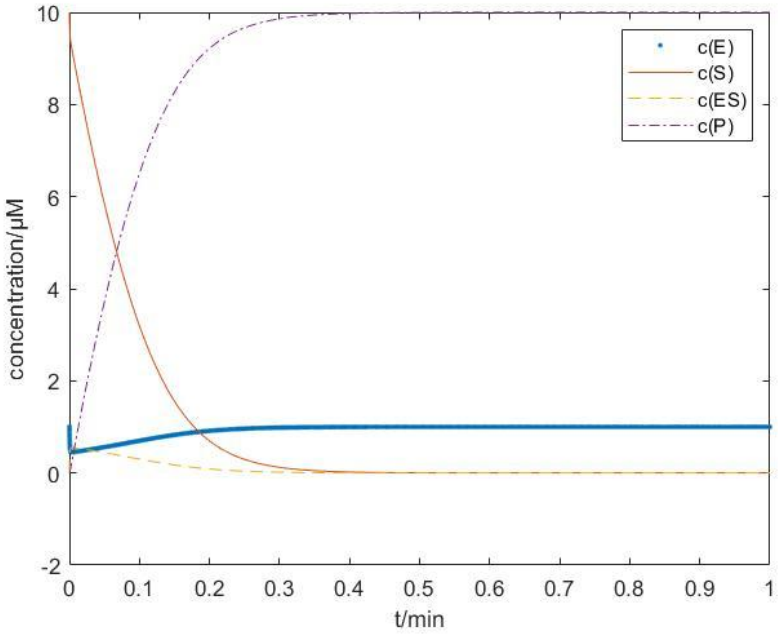
The rate of change of ES:

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

The rate of change of P:

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

8.2



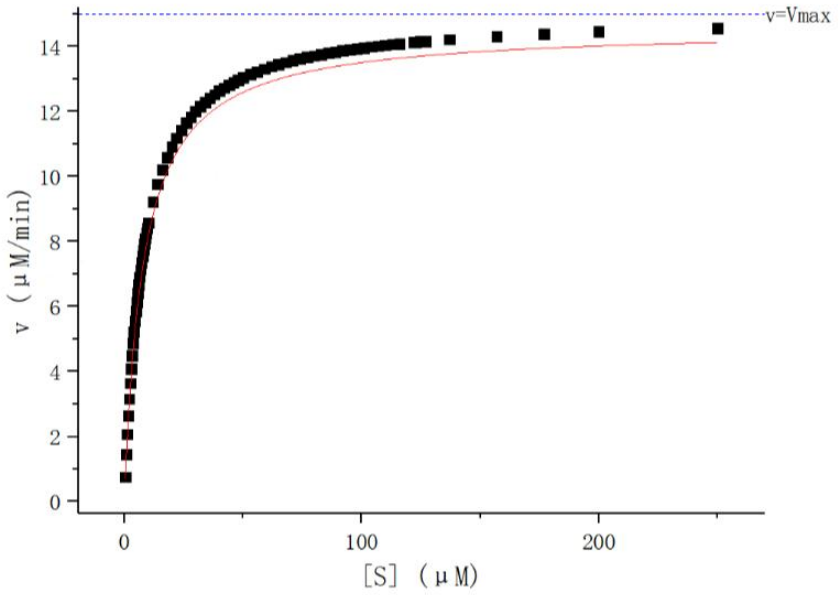
Code:(Matlab)

```
%odefun.m
function dy= fun(t,y)
dy= zeros(4,1);
dy(1)=750*y(3)-100*y(1)*y(2);
dy(2)=600*y(3)-100*y(1)*y(2);
dy(3)=100*y(1)*y(2)-750*y(3);
```

```
dy(4)=150*y(3);
end

%testtold45.m
Clear
clc
[T,Y]=ode45(@fun,[0 1],[1 10 0 0]);
plot(T,Y(:,1),'-',T,Y(:,2),'-.',T,Y(:,3),'.',T,Y(:,4),'--');
legend('c(E)','c(S)','c(ES)','c(P)');
xlabel('t/min');
ylabel('concentration/μM');
```

8.3



I used Origin to make this plot. Normally, we use Origin to fit function, after we get data from experiment. Here, I calculated the V_{max} and K_m and put them in the function of $\mathrm{V} = \frac{\mathrm{v_{max}}*[\mathrm{S}]}{\mathrm{K_m}+[\mathrm{S}]}$. After that, I simulates the data of the concentration of the substrate S and the velocity V and using Origin to plot the velocity V as a function of the concentration of the substrate S.

The functions are:
We define the velocity, V, of the enzymatic reaction to be the rate of change of the product P :

$$\mathrm{V} = \frac{d[p]}{dt} = k_3[ES]$$

Michaelis-Menten derivation:

$$k_1[E][S] = (k_2 + k_3)[ES]$$

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

$$\mathrm{K_m} = \frac{k_2 + k_3}{k_1}$$

$$\text{Since:} [E] = [E_0] - [ES], [E_0]\ is\ Enzyme\ total\ at\ T_0$$

$$[ES] = \frac{[E_0] * [\mathrm{S}]}{\mathrm{K_m} + [\mathrm{S}]}$$

$$\text{Since:}\ \mathrm{V} = k_3[ES]$$

$$\mathrm{V} = \frac{k_3[E_0] * [\mathrm{S}]}{\mathrm{K_m} + [\mathrm{S}]}$$

Since[S]>>>[E],at steady state,$[E_0]$=$[ES]$,then reaction is at $V_{max} = k_3[E_0]$, so$\mathrm{V} = \frac{\mathrm{v_{max}} * [\mathrm{S}]}{\mathrm{K_m} + [\mathrm{S}]}$.

From the plot,I could 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.