8.1

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

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

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

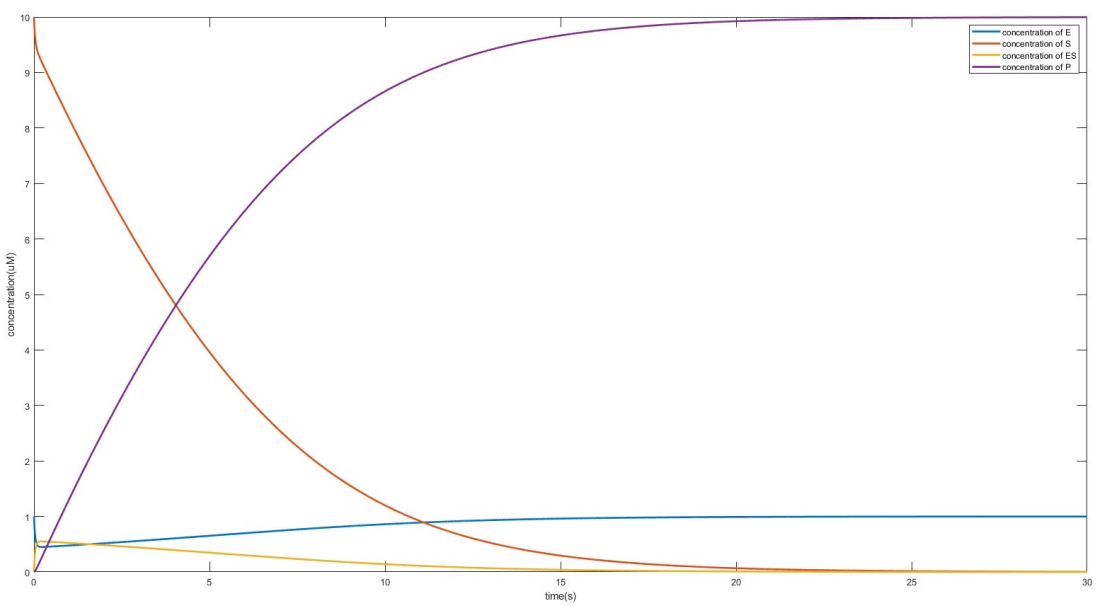
$$\frac{d[P]}{dt} = k_3[ES]$$

8.2

```
clear
%---------Runge-Kutta method-----------
[T,Y]=ode45(@fun1218,[0:0.001:30],[1 10 0 0]);%Calculate the concentration change over 30 seconds in time steps of 0.001
%The columns 1, 2, 3, 4 of Y-value are:'E concentration', 'S concentration', 'ES concentration', 'P concentration'

%Plotting concentration versus time
figure(1)
plot(T,Y(:,1),T,Y(:,2),T,Y(:,3),T,Y(:,4),'LineWidth',2)
xlabel('time(s)')
ylabel('concentration(uM)')
legend('concentration of E','concentration of S','concentration of ES','concentration of P')


function dy=fun1218(t,y)
k1=100/60;
k2=600/60;
k3=150/60;
dy=zeros(4,1);                          %Creating an empty matrix
dy(1)=-k1*y(1)*y(2)+k2*y(3)+k3*y(3);    % The differential equations used are from those found in 8.1
dy(2)=-k1*y(1)*y(2)+k2*y(3);
dy(3)=k1*y(1)*y(2)-k2*y(3)-k3*y(3);
dy(4)=k3*y(3);
end
```



8.3

```
clear
v=[];%Create an empty matrix
     %store the reaction rate at each concentration
k1=100/60;
k2=600/60;
k3=150/60;
km=(k2+k3)/k1;
%Calculate the maximum reaction rate at each concentration
for s=0:0.1:2000
[T,Y]=ode45(@fun1218,[0:0.001:0.1],[1 s 0 0]);
v1=(Y(20,4)-Y(1,4))/(T(20)-T(1));%Calculate the reaction rate using the calculated concentration
v=[v v1];
end
%Concentration from 0 to 2000 in steps of 0.1
%Calculation completed

%plotting
figure(1)
plot([0:0.1:2000],v,'color',[0.18 0.55 0.34],'LineWidth',2)
hold on
plot([0,2000],[2.5,2.5],'--','color',[0.22 0.37 0.06],'LineWidth',2)
ylim([0 2.6]);
xlabel('concentration of S (uM)')
ylabel('Reaction rate')



function dy=fun1218(t,y)
k1=100/60;
k2=600/60;
k3=150/60;
dy=zeros(4,1);                          %Creating an empty matrix
dy(1)=-k1*y(1)*y(2)+k2*y(3)+k3*y(3);
dy(2)=-k1*y(1)*y(2)+k2*y(3);
dy(3)=k1*y(1)*y(2)-k2*y(3)-k3*y(3);
dy(4)=k3*y(3);
end
```