$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_3} E + P$$

8.1

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

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

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

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

8.2

```
clc;
%% 解微分方程
x0 = [1, 10, 0, 0];
tspan = [0, 1.5];
[T, X] = ode45(@f, tspan, x0);

%% 绘图
figure;
plot(T, X(:, 1))
ylabel('E');
xlabel('Time');

figure;
plot(T, X(:, 2))
ylabel('S');
xlabel('Time');

figure;
plot(T, X(:, 3))
ylabel('ES');
xlabel('Time');

figure;
plot(T, X(:, 4))
ylabel('P');
xlabel('Time');

V=150*X(:, 3);

figure;
plot(X(:,2),V)
xlabel('S')
ylabel('V')
%% 微分方程函数
function fx = f(t, x)
    % 初始化fx，需要为列向量
    fx = zeros(4, 1);
    % 四个微分方程组
    fx(1) =750*x(3) - 100*(x(1)-x(3))*x(2) ;
    fx(2) =600*x(3)-100*(x(1)-x(3))*x(2) ;
    fx(3) =100*(x(1)-x(3))*x(2)-750*x(3);
    fx(4) =150*x(3) ;
end
```

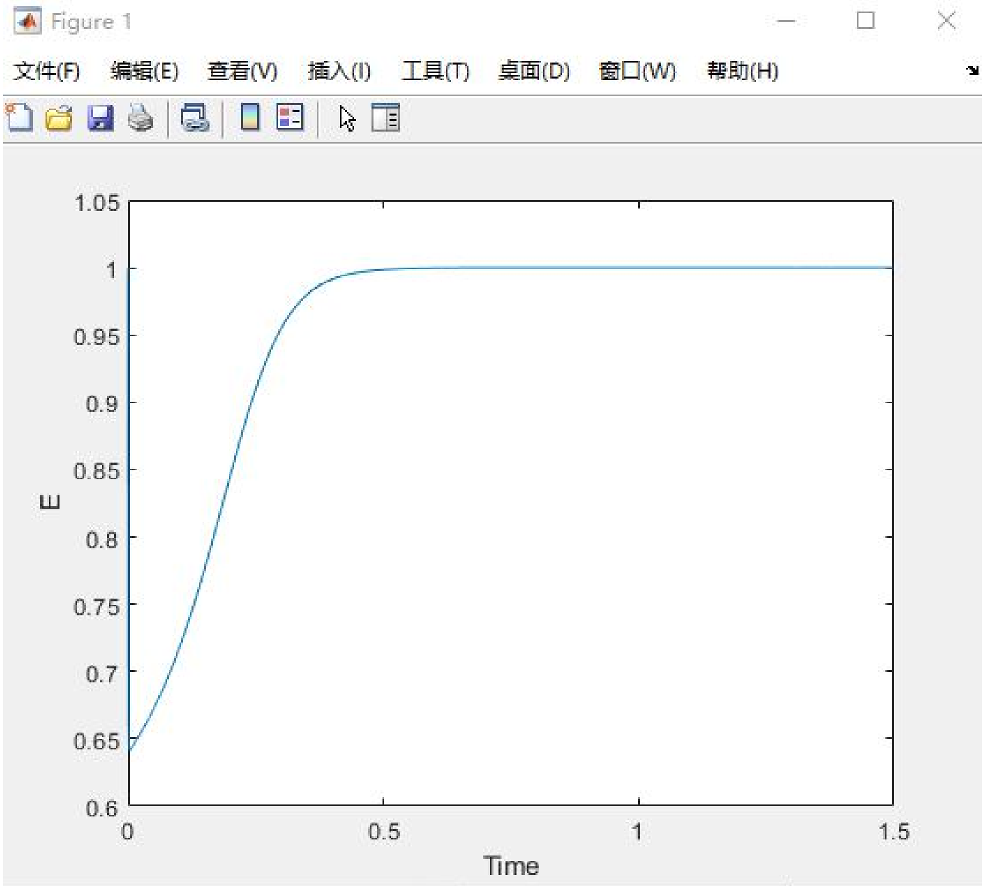


Figure 1
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
E
0
0.5
1
1.5
Time

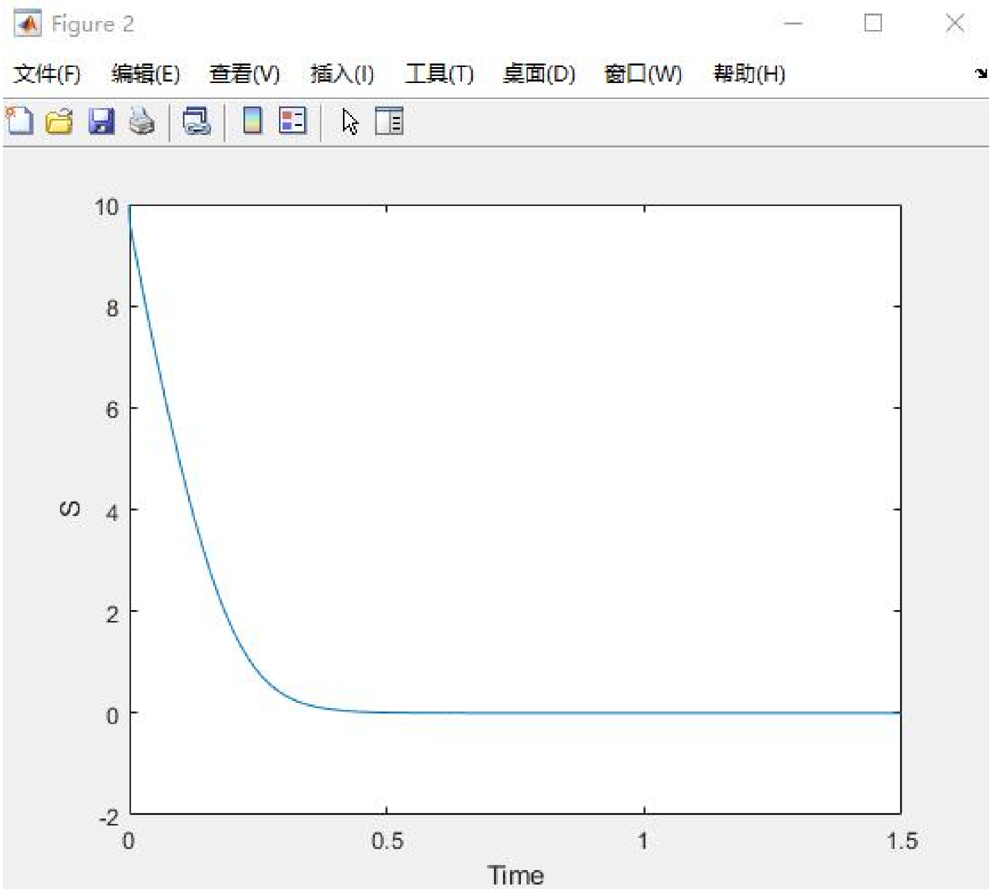


Figure 2
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
10
8
6
4
2
0
-2
S
0
0.5
1
1.5
Time

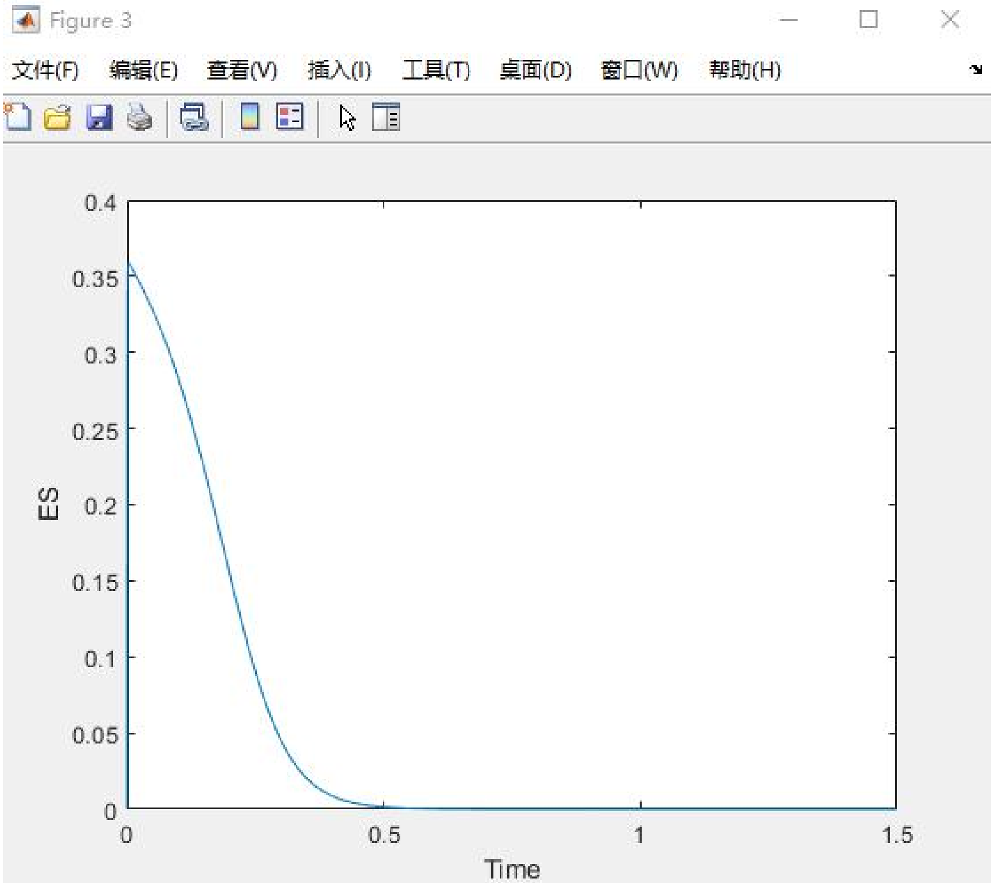


Figure 3
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
ES
0
0.5
1
1.5
Time

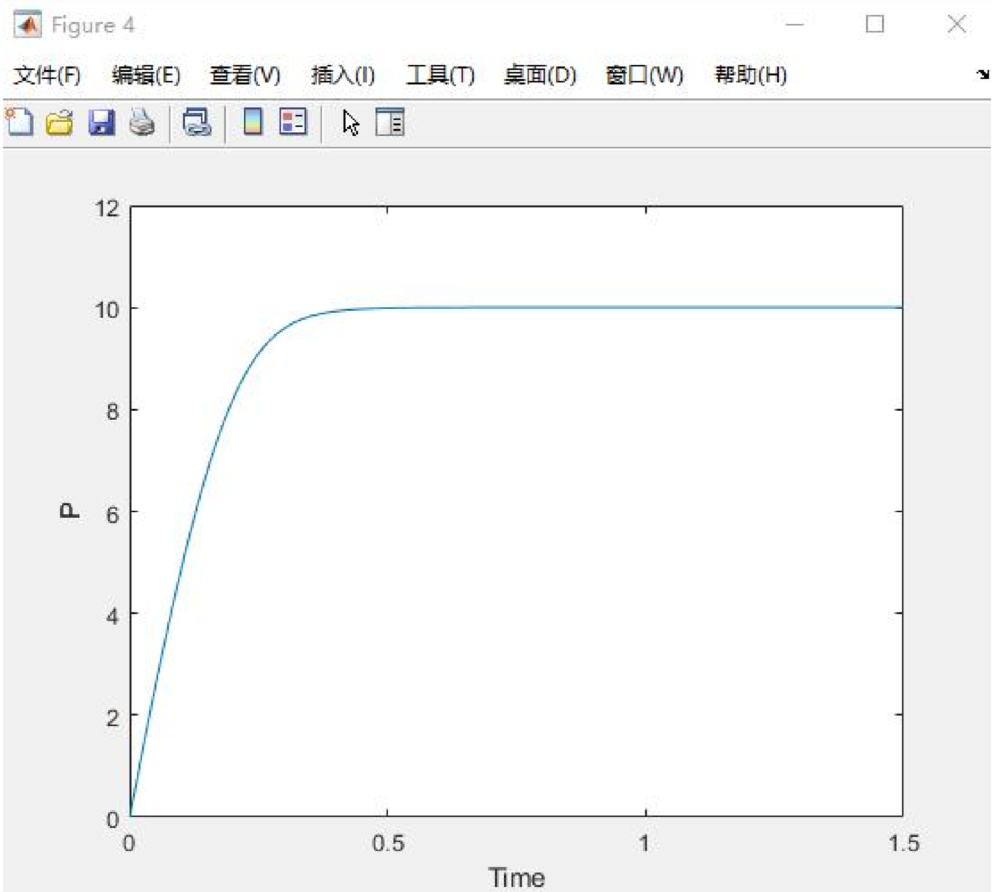
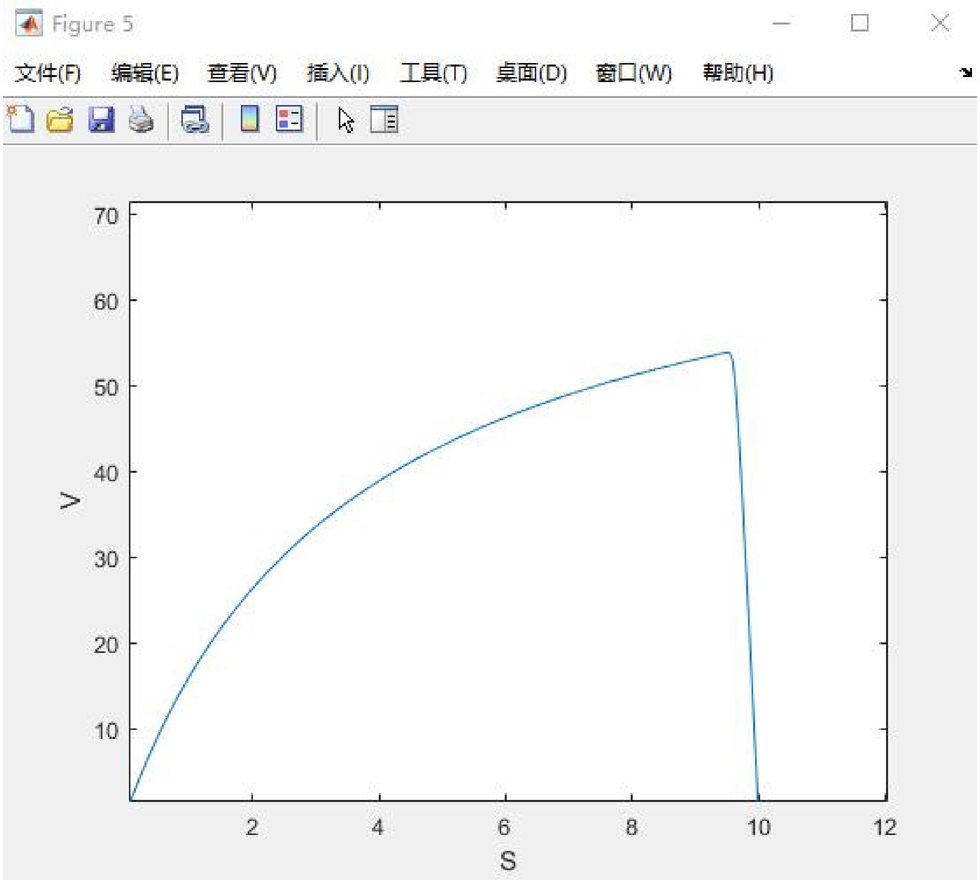


Figure 4
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
12
10
8
6
4
2
0
P
0
0.5
1
1.5
Time



8.3

$V = V_P$

When the reaction is in dynamic equilibrium, the generation rate of ES is equal to the decomposition rate：

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

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

Let $k_m = \dfrac{k_2+k_3}{k_1}$

When the S concentration is high, all E is saturated by S and converted into ES ([E]=[ES]), at this time, the V reaches Vm, then Vm=k3[ES]=k3[E], so:

$$V = k_3[ES]=\frac{k_3[E][S]}{k_m+[S]}=\frac{V_m[S]}{\mathrm{k}_m+[S]}$$

Change the above formula into the following form:

$V = V_m - k_m * \frac{V}{[S]}$, V is the vertical axis, V/[S] is the abscissa axis, so the Vm: