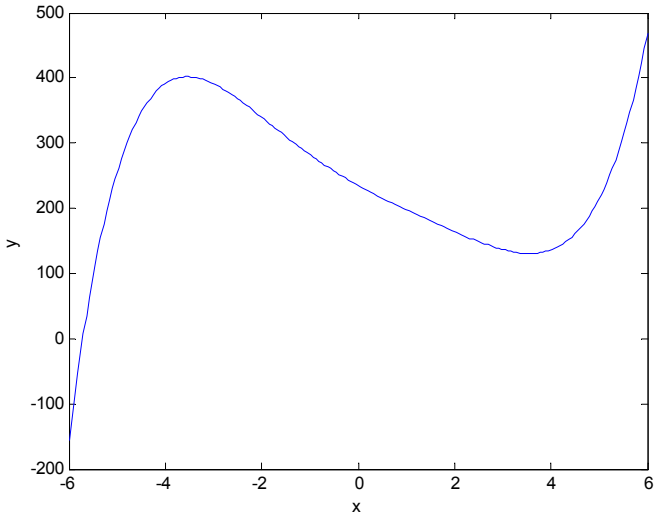
Chapter 8
Solved Problems

Problem 1

Script file:

```
clear, clc
p=[0.1 -0.2 -1 5 -41.5 235];
x=linspace(-6,6,200);
y=polyval(p,x);
plot(x,y)
xlabel('x')
ylabel('y')
```

Figure:

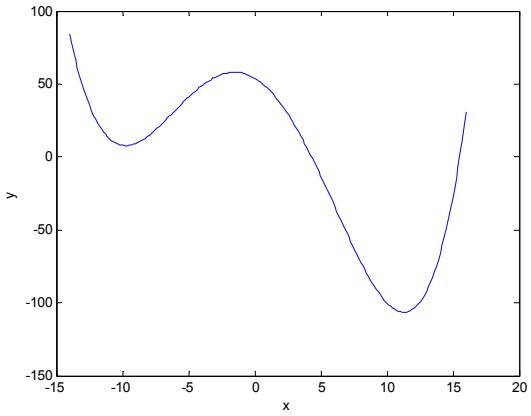


Problem 2

Script file:

```
clear, clc
p=[0.008 0 -1.8 -5.4 54];
x=linspace(-14,16,200);
y=polyval(p,x);
plot(x,y)
xlabel('x')
ylabel('y')
```

Figure:



Problem 3

Script File:

```
clear, clc
pa=[-1 0 5 -1];
pb=[1 2 0 -16 5];
c=conv(pa,pb)
```

Command Window:

```
c =
    -1    -2     5    25    -7   -80    41    -5
```

The answer is: $-x^7 - 2x^6 + 5x^5 + 25x^4 - 7x^3 - 80x^2 + 41x - 5$

Problem 4

Script file:

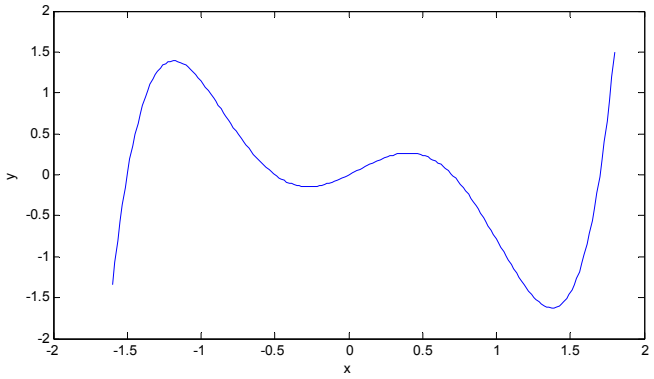
```
clear, clc
p1=[1 -1.7]; p2=[1 0.5]; p3=[1 -0.7]; p4=[1 1.5]; p5=[1 0];
p12=conv(p1,p2);
p34=conv(p3,p4);
p14=conv(p12,p34);
p=conv(p14,p5)
x=linspace(-1.6,1.8,200);
y=polyval(p,x);
plot(x,y)
xlabel('x')
ylabel('y')
```

Command Window:

```
p =
     1.0000    -0.4000    -2.8600     0.5800     0.8925
0
```

The answer is: $x^5 - 0.4x^4 - 2.86x^3 + 0.58x^2 + 0.8925x$

Figure:



Problem 5

Script File:

```
pa=[-10 -20 9 10 8 11 -3];
pb=[2 4 -1];
p=deconv(pa,pb)
```

Command Window:

```
p =
    -5     0     2     1     3
```

The answer is: $-5x^4 + 2x^2 + x + 3$

Problem 6

Script File:

```
pa=[-0.24 1.6 1.5 -7.41 -1.8 -4 -75.2 -91];
pb=[-0.8 0 5 6.5];
p=deconv(pa,pb)
```

Command Window:

```
p =
    0.3000   -2.0000         0   -0.8000  -14.0000
```

The answer is: $0.3x^4 - 2x^3 - 0.8x - 14$

Problem 7

Script file:

```
clear,clc
p1=[1 0]; p2=[1 1];
p=conv(p1,p2);
n=length(p);
p(n)=p(n)-6972;
s=roots(p)
```

Command Window:

```
s =
   -84
    83
```

The answer is: 83 and 83

Problem 8

Script file:

```
p1=[1 0]; p2=[1 5]; p3=[1 10];
p12=conv(p1,p2);
p=conv(p12,p3);
n=length(p);
p(n)=p(n)-10098;
s=roots(p)
```

Command Window:

```
s =
 -16.0000 +18.3848i
 -16.0000 -18.3848i
  17.0000 + 0.0000i
```

The answer is: 17 22 and 27

Problem 9

Mathematical formulation:

Solve the equation:

$$(V_{out} - V_{in})0.284 = 12212$$

where:

$V_{out} = 240 \cdot 120 \cdot 80$ and $V_{in} = (240 - t)(120 - t)(80 - 2t)$

Script file:

```
clear,clc
V=12212/0.284;
Vout=240*120*80;
p1=[-1 240]; p2=[-1 120]; p3=[-2 80];
pa=conv(p1,p2);
Vin=conv(pa,p3);
p=Vin;
n=length(p);
p(n)=p(n)+V-Vout;
t=roots(p)
```

Command Window:

```
t =
   1.0e+02 *
   1.9975 + 0.5568i
   1.9975 - 0.5568i
   0.0050 + 0.0000i
```

The last root is the answer: $t = 0.5$ in

Problem 10

Mathematical formulation:

$$V = \pi \cdot 10^2 \cdot 24 + \frac{4}{3}\pi 10^3 - \left[\pi \cdot (10-t)^2 \cdot 24 + \frac{4}{3}\pi(10-1.5t)^3\right] = \frac{42.27}{0.101}$$

Script File:

```
clear,clc
Cont=42.27/0.101-pi*10^2*24-4*pi*10^3/3;
p1=[-1 10];
p2=[-1.5 10];
p11=pi*24*conv(p1,p1);
p22=conv(p2,p2);
p23=4*pi/3*conv(p22,p2);
p=[0 p11]+p23+[0 0 0 Cont];
t=roots(p)
```

Command Window:

```
t =
  12.6042 + 8.8309i
  12.6042 - 8.8309i
   0.1250 + 0.0000i
```

The last root is the answer: $t = 0.125$ in

Problem 11

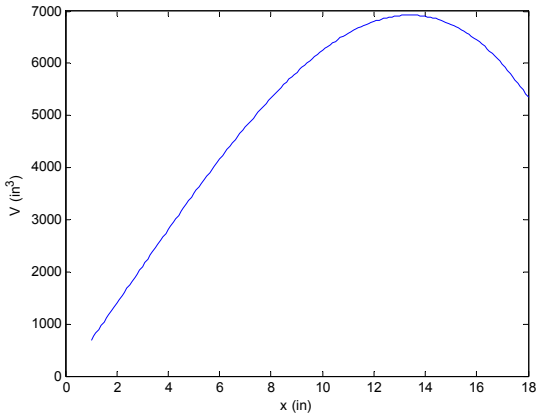
(*a*)

$$V = x(x+15)\frac{(20 \cdot 12 - 8x - 60)}{4} = x(x+15)(45-2x)$$

(*b*)
Script File:

```
p1=[1 15 0];
p2=[-2 45];
p=conv(p1, p2);
x=1:0.1:18;
V=polyval(p,x);
plot(x,V)
xlabel('x (in)')
ylabel('V (in^3)')
pder=polyder(p);
xVmaxmax=roots(pder)
Vmax=polyval(p,xVmaxmax(1))
```

Figure:



(*c*)
Command Window:

```
xVmaxmax =
   13.3972
   -8.3972
Vmax =
   6.9262e+03
```

Maximum volume 6926.2 in^3 at x=13.3972 in.

Problem 12

The volume is: $(40 - 2x)(22 - 2x)x = 4x^3 - 124x^2 + 880x$

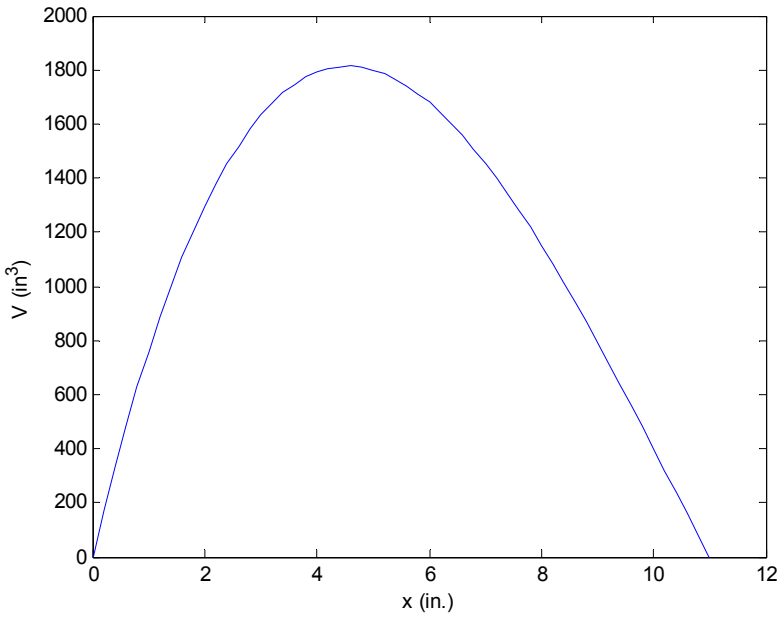
Script File:

```
% Part a
disp('Part a')
p=[4 -124 880 0]
% Part b
x=[0:0.2:11];
V=polyval(p,x);
plot(x,V)
xlabel('x (in.)')
ylabel('V (in^3)')
% Part c
disp('Part c')
pV1000=[4 -124 880 -1000];
x1000=roots(pV1000)
% Part d
disp('Part d')
pD=polyder(p); %Determine the derivative of the polynomial.
xr=roots(pD);   %Determine where the derivative is zero.
s=xr>0&xr<11;  % Find which root is between 0 and 11.
xmax=xr(s)   % Assign the root to xmax.
Vmax=polyval(p,xmax)  % Determine the root at xmax.
```

Command Window:

```
Part a
p =
     4   -124    880      0
Part c
x1000 =
   21.1625
    8.4374
    1.4001
Part d
xmax =
    4.5502
Vmax =
  1.8137e+003
```

In part c the two roots of `x1000` that apply to the problem are `8.4374` and `1.4001`.



Problem 13

User-defined function:

```
function p=polyadd(p1,p2,operation)
np1=length(p1);
np2=length(p2);
% Padding p2, if shorter than p1.
if np1>np2
    nd=np1-np2;
    p2add(1:nd)=0;
    p2=[p2add p2];
end
% Padding p1, if shorter than p2.
if np2>np1
    nd=np2-np1;
    p1add(1:nd)=0;
    p1=[p1add p1];
end
switch operation
    case 'add'
        p=p1+p2;
    case 'sub'
        p=p1-p2;
end
```

Command Window:

```
>> p1=[2 0 -3 -9 11 -8 4];
>> p2=[5 0 7 -10];
>> p1PLUSp2=polyadd(p1,p2,'add')
p1PLUSp2 =
     2     0    -3    -4    11    -1    -6
>> p1minusp2=polyadd(p1,p2,'sub')
p1minusp2 =
     2     0    -3   -14    11   -15    14
```

The answers are:

addition: $2x^6 - 3x^4 - 4x^3 + 11x^2 - x - 6$

subtraction: $2x^6 - 3x^4 - 14x^3 + 11x^2 - 15x + 14$

Problem 14

User-defined function:

```
function p = polymult(p1,p2)
%Multiply polynomials
na=length(p1); nb=length(p2);
if nb > na
    d=p1; p1=p2;
    clear b
    p2=d;
    nd=na; na=nb; nb=nd;
end
for k=1:nb
    p(k)=0;
    for i=1:k
        p(k)=p(k)+p1(i)*p2(k+1-i);
    end
end
for k=nb+1:na
    p(k)=0;
    for i=k-nb+1:k
        p(k)=p(k)+p1(i)*p2(k+1-i);
    end
end
for k=na+1:na+nb-1
    p(k)=0;
    for i=k-nb+1:na
        p(k)=p(k)+p1(i)*p2(k+1-i);
    end
end
```

Command Window:

```
>> pa=[2 0 -3 -9 11 -8 4];
>> pb=[5 0 7 -10];
>> pab = polymult(pa,pb)
pab =
```

```
    10     0    -1   -65    34   -73   187  -166   108
-40
>> conv(pa,pb)
ans =
    10     0    -1   -65    34   -73   187  -166   108
-40
```

Problem 15

User-defined function:

```
function [x, y, W] = maxormin(a,b,c)
x=-b/(2*a);
y=a*x^2+b*x+c;
W=2;
if a<0
    W=1;
end
```

Command Window:

8.*a*

```
>> [x y w]=maxormin(3, -7, 14)
x =
    1.1667
y =
    9.9167
w =
     2
```

8.*b*

```
>> [x y w]=maxormin(-5, -11, 15)
x =
   -1.1000
y =
   21.0500
w =
     1
```

Problem 16

Mathematical formulation:

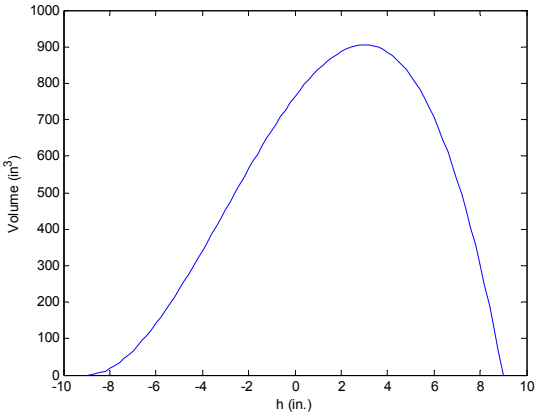
$$V = \frac{\pi}{3}(R^2 - h^2)(R + h) = \frac{\pi}{3}(-h^3 - Rh^2 + R^2h + R^3)$$

Script file:

```
R=9; V=500;
h=9:-0.2:-9;
% Part (a)
p=[-1 -R R^2 R^3];
Vh=polyval(p,h)*pi/3;
% Part (b)
plot(h,Vh)
xlabel('h (in.)')
ylabel('Volume (in^3)')
% Part (c)
disp('Part (c)')
hV500=[-1 -R R^2 R^3-3*V/pi];
h500=roots(hV500)
% Part (d)
disp('Part (d)')
Vpd=polyder(p);
rVmax=roots(Vpd)
Vmax=polyval(p,rVmax(2))*pi/3
```

Command Window:

```
Part (c)
h500 =
  -13.5967
    7.1751
   -2.5783
Part (d)
rVmax =
    -9
     3
Vmax =
  904.7787
```


1000
900
800
700
600
500
400
300
200
100
0
Volume (in^3)
-10
-8
-6
-4
-2
0
2
4
6
8
10
h (in.)

Problem 17

Mathematical formulation:

$$d^2 = (x-3)^2 + [5.5 - [1.5(x-3)^2 + 1]]^2$$

$$d^2 = 2.25x^4 - 27x^3 + 109x^2 - 168x + 90$$

Script file:

```
Y=@ (x) 1.5*(x-3)^2+1;
p=[2.25 -27 109 -168 90];
x=3:0.05:6;
d2=polyval(p,x);
d=sqrt(d2);
% Part(b)
plot(x,d)
xlabel('x')
ylabel('y')
% Part(c)
pQ=[2.25 -27 109 -168 90-28^2];
disp('Part (c)')
xQd28=roots(pQ)
yQd28=Y(xQd28(1))
yQd28=Y(xQd28(4))
% Part(d)
disp('Part (d)')
pder=polyder(p);
xQdmin=roots(pder)
yQmin1=Y(xQdmin(1))
yQmin2=Y(xQdmin(3))
Qdmin1=sqrt(polyval(p,xQdmin(1)))
Qdmin2=sqrt(polyval(p,xQdmin(3)))
```

Command Window:

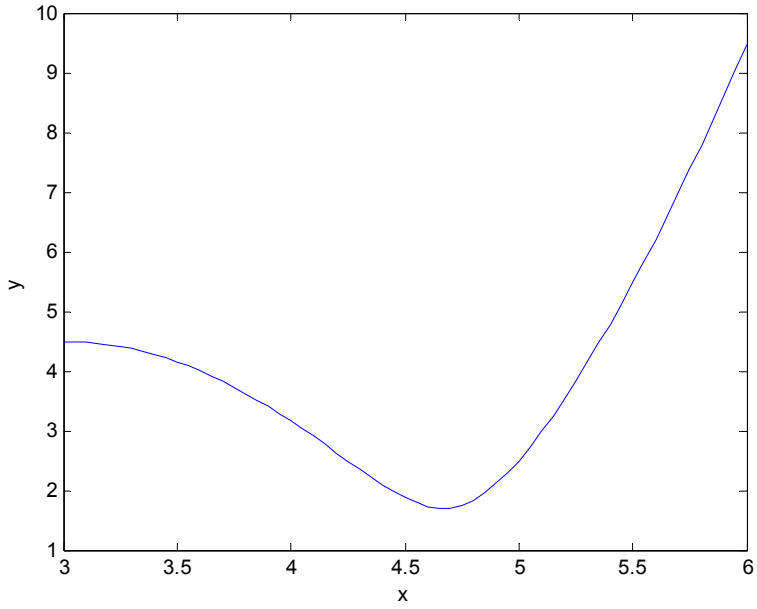
```
Part (c)
xQd28 =
   7.6271 + 0.0000i
   3.0000 + 3.9818i
   3.0000 - 3.9818i
  -1.6271 + 0.0000i
yQd28 =
   33.1150
yQd28 =
   33.1150
Part (d)
xQdmin =
    4.6667
    3.0000
    1.3333
yQmin1 =
    5.1667
yQmin2 =
    5.1667
Qdmin1 =
    1.6997
Qdmin2 =
    1.6997
```

Answers:

Part (*c*): (7.627, 33.115) and (-1.627, 33.115)

Part (*d*): (4.6667, 5.1667) and (1.333, 5.1667); d= 1.6997

Figure:



Problem 18

Script file:

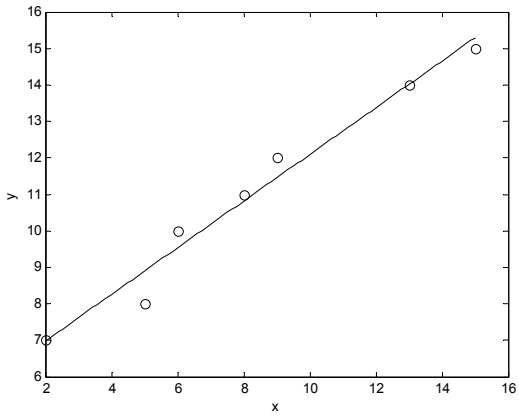
```
x=[2 5 6 8 9 13 15];
y=[7 8 10 11 12 14 15];
p1=polyfit(x,y,1)
xplot=linspace(2,15,100);
yplot=polyval(p1,xplot);
plot(x,y,'ok',xplot,yplot,'k')
xlabel('x')
ylabel('y')
```

Command Window:

```
p1 =
    0.6400    5.6968
```

The function is: $y = 0.64x + 5.6968$

Figure:



Problem 19

Script file:

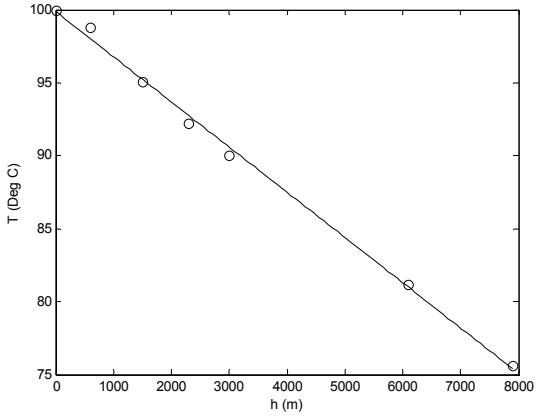
```
hsi=[0 600 1500 2300 3000 6100 7900];
Tsi=[100 98.8 95.1 92.2 90 81.2 75.6];
p=polyfit(hsi,Tsi,1)
T5000=polyval(p,5000)
xplot=linspace(0,7900,100);
yplot=polyval(p,xplot);
plot(hsi,Tsi,'ok',xplot,yplot,'k')
xlabel('h (m)')
ylabel('T (Deg C)')
```

Command Window:

```
p =
   -0.0031   99.8863
T5000 =
   84.394
```

The equation is: $T_B = (-0.0031)h + 99.8863$

Figure:



Problem 20

Script file:

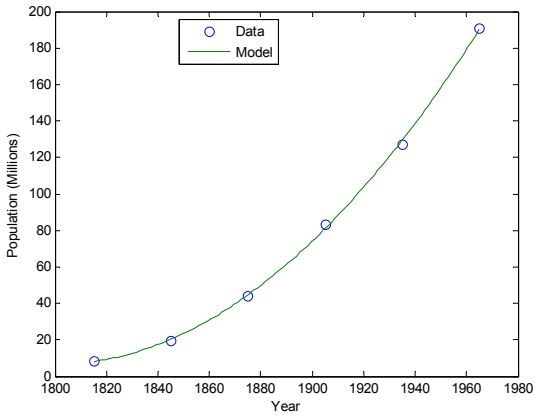
```
Y=[1815 1845 1875 1905 1935 1965];
t=Y-1800;
Pop=[8.3 19.7 44.4 83.3 127.1 190.9];
p=polyfit(t,Pop,2)
tp=linspace(1815,1965,100);
Pplot=polyval(p,tp-1800);
plot(Y,Pop,'o',tp,Pplot)
xlabel('Year')
ylabel('Population (Millions)')
legend('Data','Model',0)
Pop1915=polyval(p,1915-1800)
```

Command Window:

```
p =
           0.006714285714286           0.004857142857143
6.502142857142869
Pop1915 =
  95.857142857142904
```

The equation is: $P = 0.006714t^3 + 0.004857t^2 + 95.857$

Figure:



Problem 21

Script file:

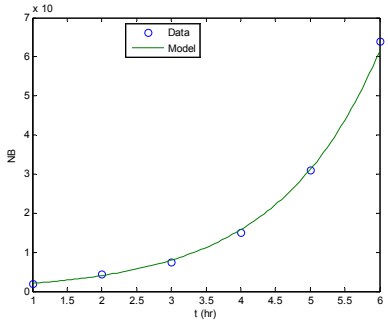
```
t=[1:6];
NB = [2 4.5 7.5 15 31 64]*1000;
p=polyfit(t,log(NB),1);
m=p(1)
b=exp(p(2))
tp=linspace(1,6,100);
F=@ (x) b*exp(m*x);
NBp=F(tp);
plot(t,NB,'o',tp,NBp)
xlabel('t (hr)')
ylabel('NB')
legend('Data','Model',0)
NB45=F(4.5)
```

Command Window:

```
m =
   0.680330174791006
b =
     1.038404848371576e+03
NB45 =
     2.217956839632734e+04
```

The equation is: $N_B = 1038.4e^{0.68033t}$

Figure:



Problem 22

Rewrite the equation in the form: $\frac{C}{H} - 1 = Ae^{-Bt}$.

This equation can be written in a linear form:

$$\ln\left(\frac{C}{H} - 1\right) = Ae^{-Bt} = \ln A + (-B)$$

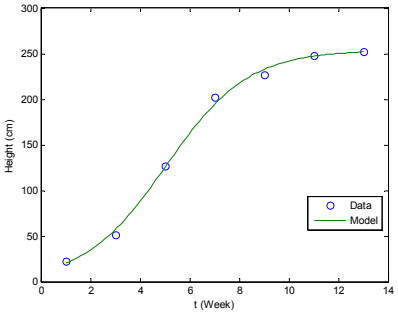
Script file:

```
C=254;
w=[1:2:13];
H = [22 51 127 202 227 248 252];
y=C./H-1;
p=polyfit(w,log(y),1);
B=-p(1)
A=exp(p(2))
wp=linspace(1,13,100);
F=@ (x) C./(1+A*exp(-B*x));
Hp=F(wp);
plot(w,H,'o',wp,Hp)
xlabel('t (Week)')
ylabel('Height (cm)')
legend('Data','Model',0)
H6=F(6)
```

Command Window:

```
B =
   0.605556122745790
A =
  21.161356448001833
H6 =
     1.628989083579548e+02
```

Figure:


300
250
200
150
100
50
0
Height (cm)
0
2
4
6
8
10
12
14
t (Week)
Data
Model

Problem 23

Script file:

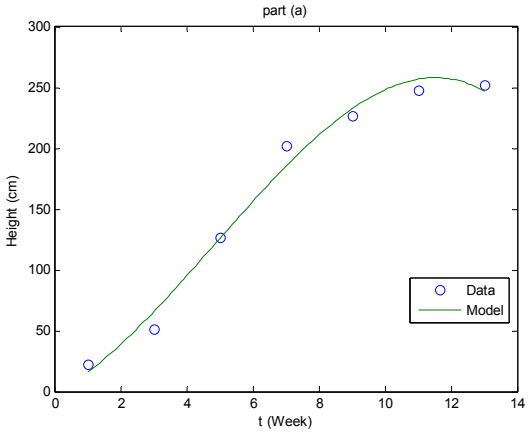
```
w=[1:2:13];
H = [22 51 127 202 227 248 252];
% Part (a)
disp('Part (a)')
p=polyfit(w,H,3);
wp=linspace(1,13,100);
Hp=polyval(p,wp);
plot(w,H,'o',wp,Hp)
xlabel('t (Week)')
ylabel('Height (cm)')
legend('Data','Model',0)
title('part (a)')
H6_Part_a=polyval(p,6)
% Part (b)
disp('Part (b)')
wp=linspace(1,13,100);
HpLin=interp1(w,H,wp,'linear');
HpSpl=interp1(w,H,wp,'spline');
figure
plot(w,H,'o',wp,HpLin,wp,HpSpl)
xlabel('t (Week)')
ylabel('Height (cm)')
legend('Data','Linear Interpolation','Spline
Interpolation',0)
title('part (b)')
H6_Part_bLinear=interp1(w,H,6,'linear')
H6_Part_bSpline=interp1(w,H,6,'spline')
```

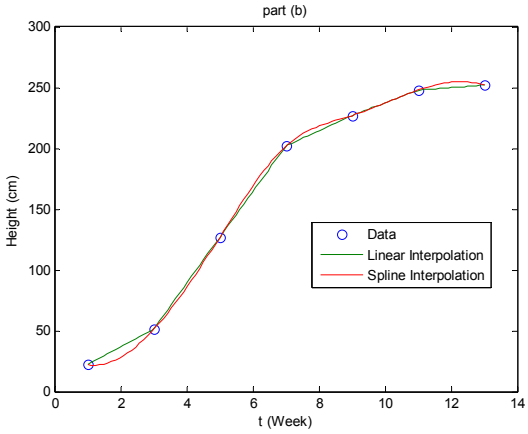
Command Window:

```
Part (a)
H6_Part_a =
  156.1830
Part (b)
H6_Part_bLinear =
```

```
  164.5000
H6_Part_bSpline =
  169.1451
```

Figures:



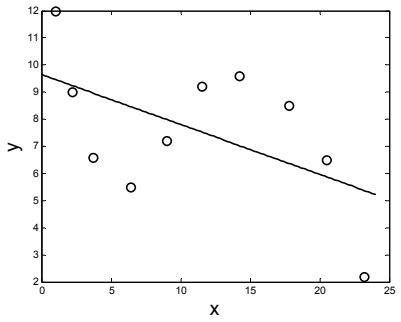


Problem 24

24.*a*

Script File:

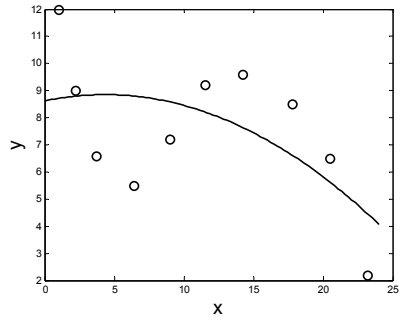
```
x=[1 2.2 3.7 6.4 9 11.5 14.2
17.8 20.5 23.2];
y=[12 9 6.6 5.5 7.2 9.2 9.6 8.5
6.5 2.2];
p1=polyfit(x,y,1);
xplot=linspace(0,24,100);
yplot=polyval(p1,xplot);
plot(x,y,'ok',xplot,yplot,'k',
'linewidth',2,'markersize',8)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```



24.*b*

Script File:

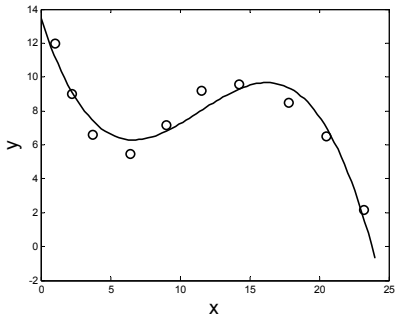
```
x=[1 2.2 3.7 6.4 9 11.5 14.2
17.8 20.5 23.2];
y=[12 9 6.6 5.5 7.2 9.2 9.6 8.5
6.5 2.2];
p1=polyfit(x,y,2);
xplot=linspace(0,24,100);
yplot=polyval(p1,xplot);
plot(x,y,'ok',xplot,yplot,'k',
'linewidth',2,'markersize',8)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```



24.*c*

Script File:

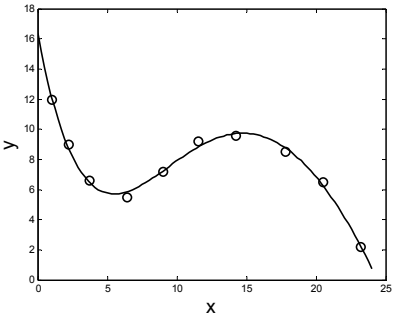
```
x=[1 2.2 3.7 6.4 9 11.5 14.2
17.8 20.5 23.2];
y=[12 9 6.6 5.5 7.2 9.2 9.6 8.5
6.5 2.2];
p1=polyfit(x,y,3);
xplot=linspace(0,24,100);
yplot=polyval(p1,xplot);
plot(x,y,'ok',xplot,yplot,'k',
'linewidth',2,'markersize',8)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```



24.*d*

Script File:

```
x=[1 2.2 3.7 6.4 9 11.5 14.2
17.8 20.5 23.2];
y=[12 9 6.6 5.5 7.2 9.2 9.6 8.5
6.5 2.2];
p1=polyfit(x,y,5);
xplot=linspace(0,24,100);
yplot=polyval(p1,xplot);
plot(x,y,'ok',xplot,yplot,'k',
'linewidth',2,'markersize',8)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```

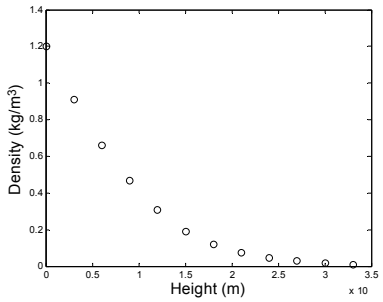


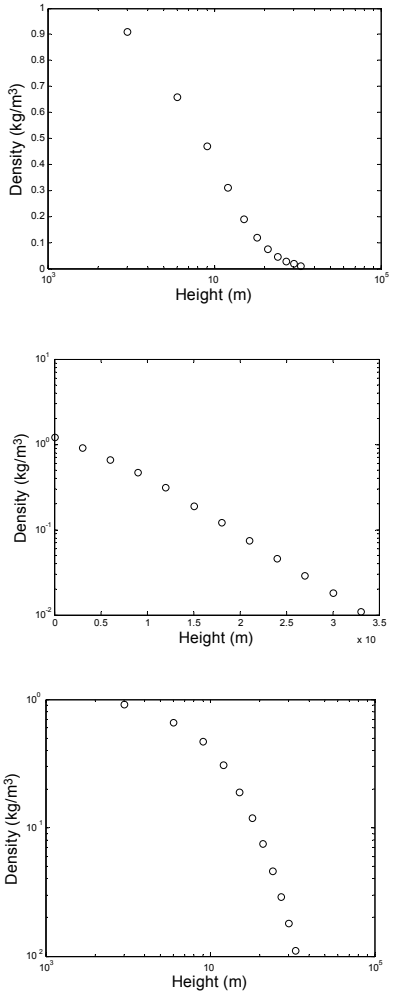
Problem 25

(*a*)
Script file :

```
h=0:3000:33000;
Den=[1.2 0.91 0.66 0.47 0.31 0.19 0.12 0.075 0.046 0.029
0.018 0.011];
plot(h, Den,'ok')
xlabel('\fontsize{16}Height (m)')
ylabel('\fontsize{16}Density (kg/m^3)')
figure
semilogx(h, Den,'ok')
xlabel('\fontsize{16}Height (m)')
ylabel('\fontsize{16}Density (kg/m^3)')
figure
semilogy(h, Den,'ok')
xlabel('\fontsize{16}Height (m)')
ylabel('\fontsize{16}Density (kg/m^3)')
figure
loglog(h, Den,'ok')
xlabel('\fontsize{16}Height (m)')
ylabel('\fontsize{16}Density (kg/m^3)')
```

When the script file is executed four Figure Windows with the following figures open.





(*b*)
Fit the data with exponential function since the data points in the third plot appear to approximately be along a straight line.

Script file: (Determines the constants of the exponential function that best fits the data, and then plots the function and the points in a linear axes plot.)

```
h=0:3000:33000;
Den=[1.2 0.91 0.66 0.47 0.31 0.19 0.12 0.075 0.046 0.029
0.018 0.011];
p=polyfit(h,log(Den),1);
m=p(1)
```

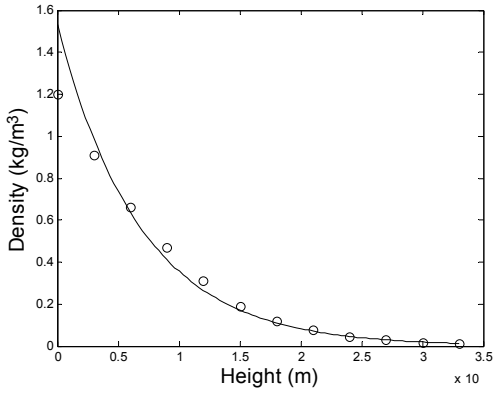
```
b=exp(p(2))
heq=linspace(0,33000,100);
Deq=b*exp(m*heq);
plot(h, Den,'ok',heq,Deq,'k')
xlabel('\fontsize{16}Height (m)')
ylabel('\fontsize{16}Density (kg/m^3)')
```

Command Window:

```
m =
 -1.4584e-004
b =
    1.5302
```

The function is: $D = 1.5302e^{(-1\ 4584 \times 10^{-4})h}$

The following figure is displayed:



Problem 26

User-defined function:

```
function [b,m]=powerfit(x,y)
p=polyfit(log(x),log(y),1);
m=p(1);
b=exp(p(2));
```

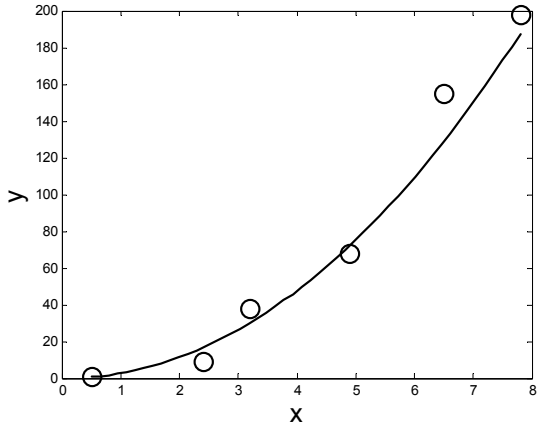
Script File:

```
x=[0.5 2.4 3.2 4.9 6.5 7.8];
y=[0.8 9.3 37.97 68.2 155 198];
[b, m]=powerfit(x,y)
xp=linspace(0.5,7.8,50);
yp=b*xp.^m;
plot(x,y,'ok',xp,yp,'k','linewidth',2,'markersize',12)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```

Command Window:

```
b =
    2.7808
m =
    2.0496
```

Figure displayed:



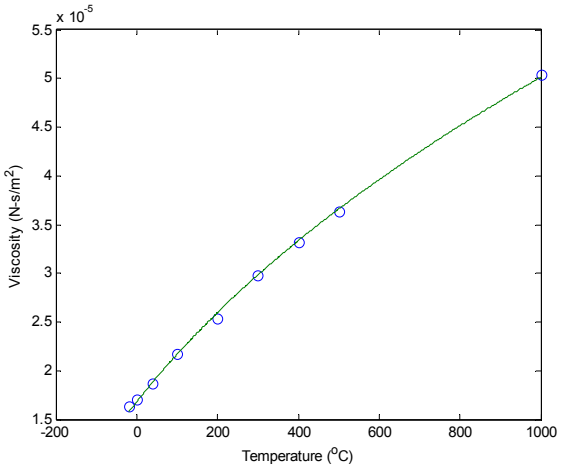
Problem 27

Script File:

```
T=[-20 0 40 100 200 300 400 500 1000];
TK=T+273.15;
meu=[1.63 1.71 1.87 2.17 2.53 2.98 3.32 3.64 5.04]*1e-5;
y=TK.^(3/2)./meu;
a=polyfit(TK,y,1)
C=1/a(1)
S=C*a(2)
Tp=-20:2:1000;
TpK=Tp+273.15;
meup=C*TpK.^(3/2)./(TpK+S);
plot(T,meu,'o',Tp,meup)
xlabel('Temperature (^oC)')
ylabel('Viscosity (N-s/m^2)')
```

Command Window:

```
a =
  1.0e+007 *
    0.0638    9.4479
C =
  1.5682e-006
S =
  148.1622
```



Problem 28

(*a*)

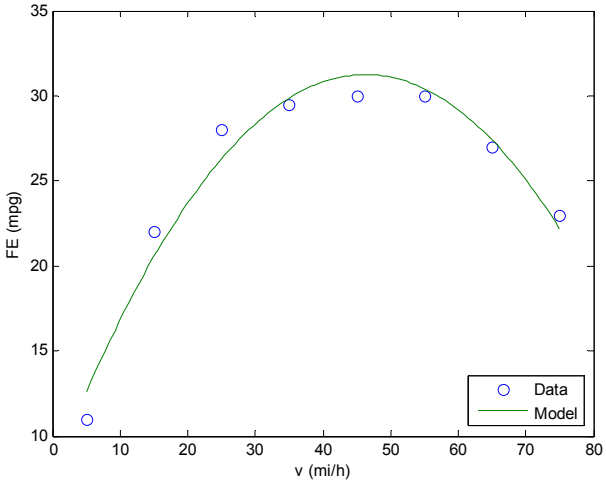
Script File:

```
v=[5:10:75];
FE = [11 22 28 29.5 30 30 27 23];
p=polyfit(v,FE,2);
xp=linspace(5,75,100);
yp=polyval(p,xp);
plot(v,FE,'o',xp,yp)
xlabel('v (mi/h)')
ylabel('FE (mpg)')
legend('Data','Model',0)
FE60=polyval(p,60)
```

Command Window:

```
FE60 =
   29.1853
```

Figure:



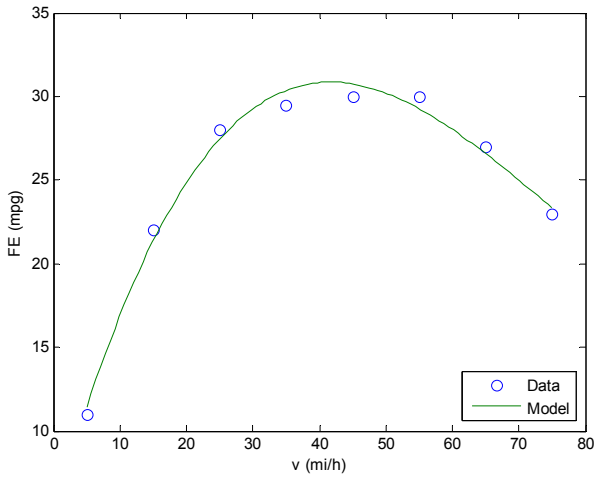
(*b*)
Script File:

```
v=[5:10:75];
FE = [11 22 28 29.5 30 30 27 23];
p=polyfit(v,FE,3);
xp=linspace(5,75,100);
yp=polyval(p,xp);
plot(v,FE,'o',xp,yp)
xlabel('v (mi/h)')
ylabel('FE (mpg)')
legend('Data','Model',0)
FE60=polyval(p,60)
```

Command Window:

```
FE60 =
   28.0319
```

Figure:



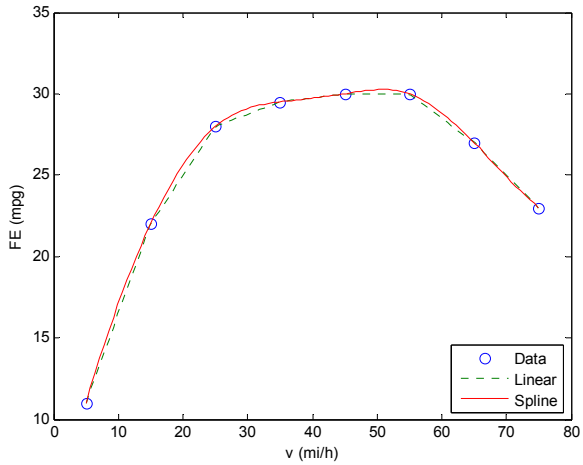
(*c*)
Script File:

```
v=[5:10:75];
FE = [11 22 28 29.5 30 30 27 23];
xp=linspace(5,75,100);
ypL=interp1(v,FE,xp,'linear');
ypS=interp1(v,FE,xp,'spline');
plot(v,FE,'o',xp,ypL,':',xp,ypS)
xlabel('Year')
xlabel('v (mi/h)')
ylabel('FE (mpg)')
legend('Data','Linear','Spline',0)
FE60L=interp1(v,FE,60,'linear')
FE60S=interp1(v,FE,60,'spline')
```

Command Window:

```
FE60L =
   28.5000
FE60S =
   28.8343
```

Figure:



Problem 29

Script File:

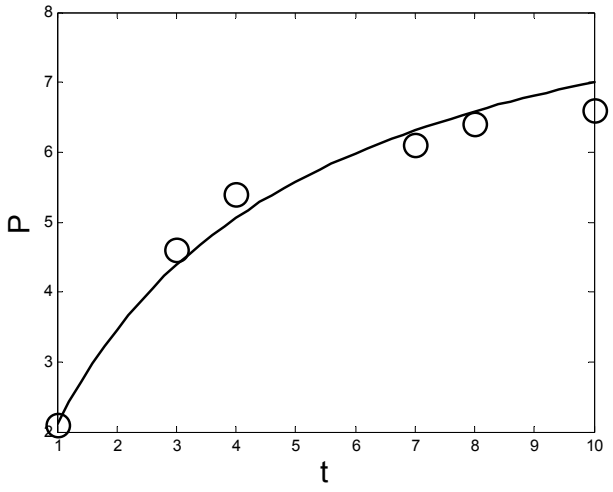
```
t=[1 3 4 7 8 10];
P=[2.1 4.6 5.4 6.1 6.4 6.6];
overt=1./t;
Pover=1./P;
a=polyfit(overt,Pover,1);
m=1/a(2)

b=m*a(1)
tp=1:0.2:10;
Pp=m*tp./(b+tp);
%plot(t,P,'o',tp,Pp)
plot(t,P,'ok',tp,Pp,'k','linewidth',2,'markersize',14)
xlabel('t','fontsize',18)
ylabel('P','fontsize',18)
```

Command Window:

```
m =
    9.4157
b =
    3.4418
```

Figure:



Problem 30

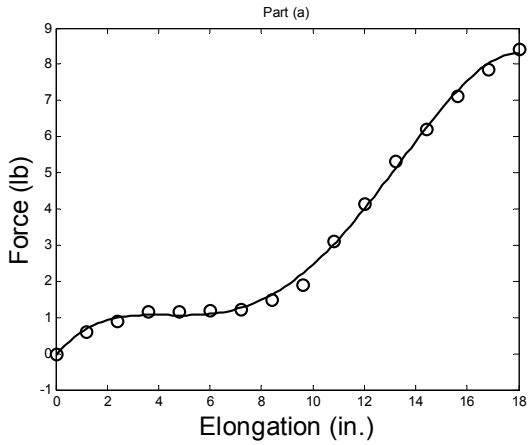
Script File:

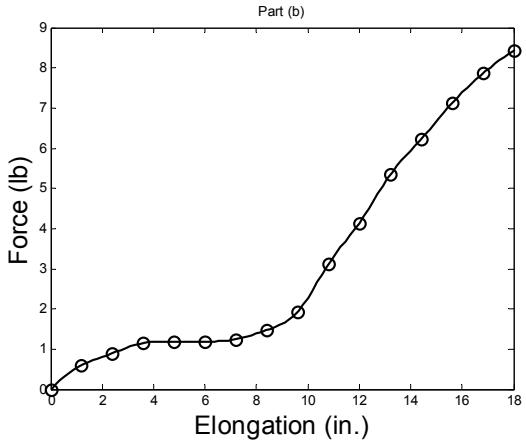
```
F=[0 0.6 0.9 1.16 1.18 1.19 1.24 1.48 1.92 3.12 4.14 5.34
6.22 7.12 7.86 8.42];
E=0:1.2:18;
%Part (a)
disp('Part (a)')
p1=polyfit(E,F,4);
Eplot=linspace(0,18,100);
Fplot=polyval(p1,Eplot);
plot(E,F,'ok',Eplot,Fplot,'k','linewidth',2,'markersize',8)
xlabel('Elongation (in.)','fontsize',18)
ylabel('Force (lb)','fontsize',18)
title('Part (a)')
ForceE115=polyval(p1,11.5)
%Part (b)
disp('Part (b)')
Eplot=linspace(0,18,100);
Fplot=interp1(E,F,Eplot,'spline');
figure
plot(E,F,'ok',Eplot,Fplot,'k','linewidth',2,'markersize',8)
xlabel('Elongation (in.)','fontsize',18)
ylabel('Force (lb)','fontsize',18)
title('Part (b)')
ForceE115=interp1(E,F,11.5,'spline')
```

Command Window:

```
Part (a)
ForceE115 =
    3.5720
Part (b)
ForceE115 =
    3.7182
```

Figures:


Part (a)
Force (lb)
Elongation (in.)
-1
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
16
18


Part (b)
Force (lb)
Elongation (in.)
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
16
18

Problem 31

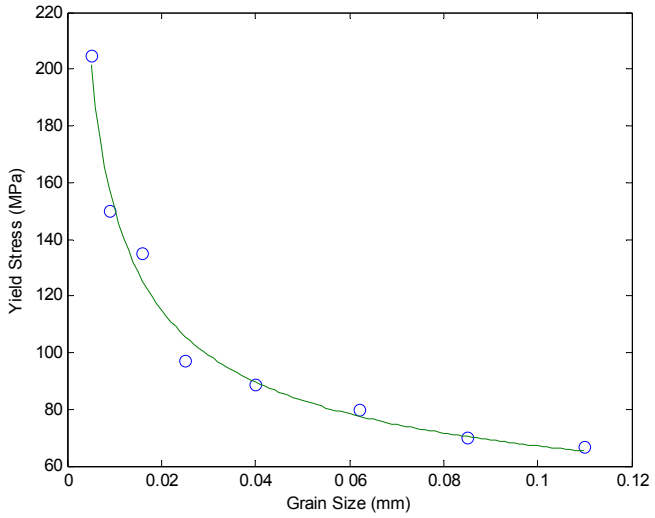
Part *a*

Script File:

```
d=[0.005 0.009 0.016 0.025 0.04 0.062 0.085 0.11];
Sy=[205 150 135 97 89 80 70 67];
x=d.^(-0.5);
p=polyfit(x,Sy,1);
k=p(1)
S0=p(2)
Sy05=S0+k*(0.05)^(-0.5)
dp=0.005:0.001:0.11;
Syp=S0+k*dp.^(-0.5);
plot(d,Sy,'o',dp,Syp)
xlabel('Grain Size (mm)')
ylabel('Yield Stress (MPa)')
```

Command Window:

```
k =
   12.2603
S0 =
   28.2938
Sy05 =
   83.1237
```



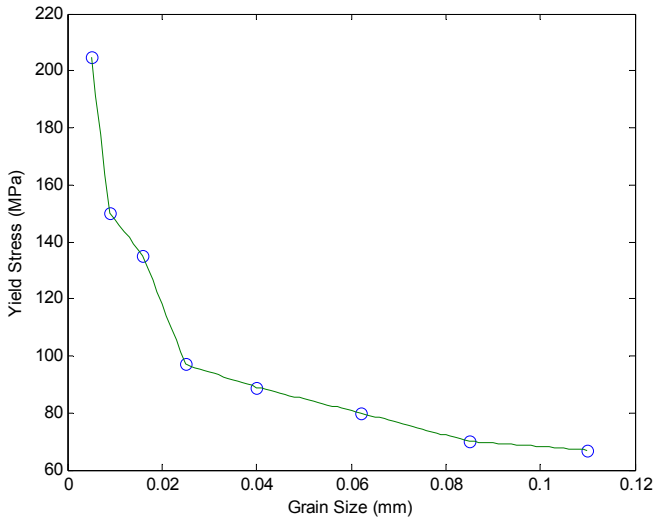
Part *b*

Script File:

```
d=[0.005 0.009 0.016 0.025 0.04 0.062 0.085 0.11];
Sy=[205 150 135 97 89 80 70 67];
Sy05L=interp1(d,Sy,0.05,'linear')
dp=0.005:0.001:0.11;
SyL=interp1(d,Sy,dp,'linear');
plot(d,Sy,'o',dp,SyL)
xlabel('Grain Size (mm)')
ylabel('Yield Stress (MPa)')
```

Command Window:

```
Sy05L =
   84.9091
```



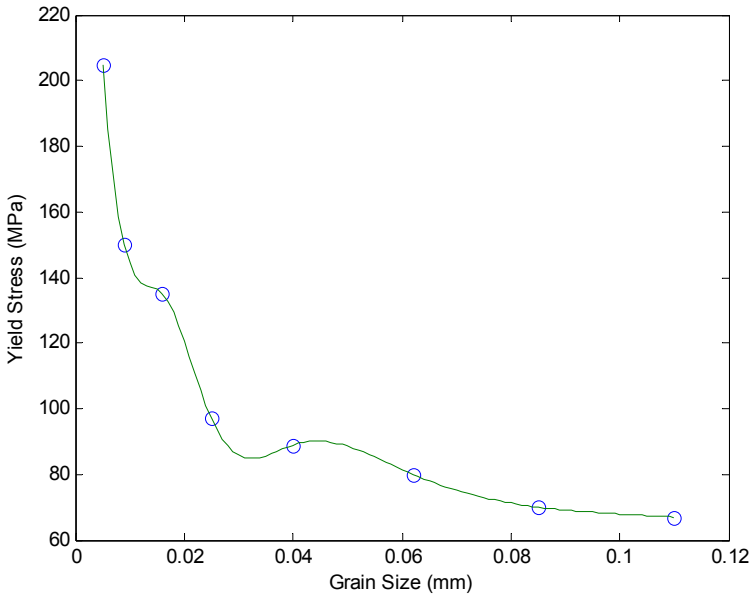
Part *c*

Script File:

```
d=[0.005 0.009 0.016 0.025 0.04 0.062 0.085 0.11];
Sy=[205 150 135 97 89 80 70 67];
Sy05S=interp1(d,Sy,0.05,'spline')
dp=0.005:0.001:0.11;
SyS=interp1(d,Sy,dp,'spline');
plot(d,Sy,'o',dp,SyS)
xlabel('Grain Size (mm)')
ylabel('Yield Stress (MPa)')
```

Command Window:

```
Sy05S =
   88.5457
```



Problem 32

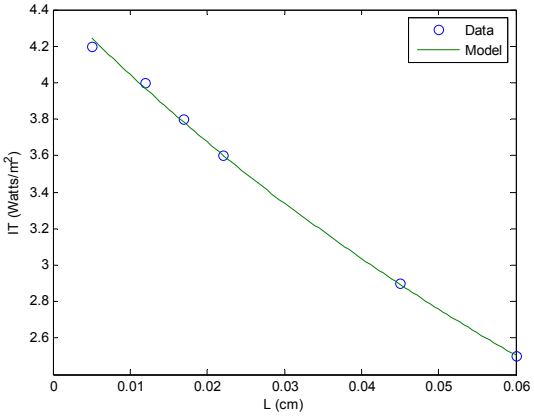
Script file:

```
I0=5;
L=[0.5 1.2 1.7 2.2 4.5 6]*1E-2;
IT = [4.2 4.0 3.8 3.6 2.9 2.5];
p=polyfit(L,log(IT),1);
beta=-p(1)
b=exp(p(2))
R=1-sqrt(b/I0)
n=(1+R^2)/(1-R^2)
Lp=linspace(0.005,0.06,100);
F=@ (x) I0*(1-R)^2*exp(-beta*x);
ITp=F(Lp);
plot(L,IT,'o',Lp,ITp)
xlabel('L (cm)')
ylabel('IT (Watts/m^2)')
legend('Data','Model',0)
```

Command Window:

```
beta =
    9.5611
b =
    4.4502
R =
    0.0566
n =
    1.0064
```

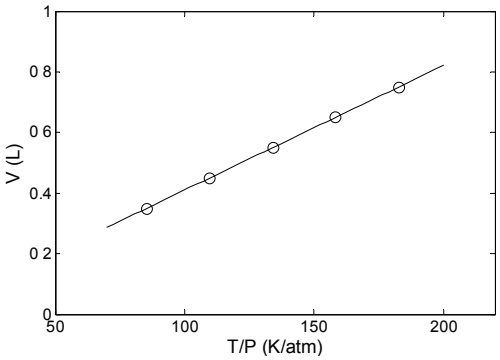
Figure


Data
Model
IT (Watts/m2)
L (cm)
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
0
0.01
0.02
0.03
0.04
0.05
0.06

Problem 33

Script file:

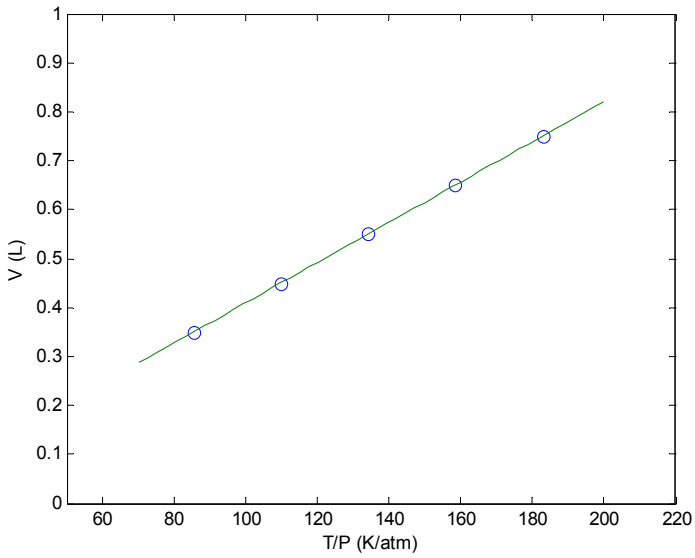
```
n=0.05;
V=[0.75 0.65 0.55 0.45 0.35
T=[25 37 45 56 65];
P=[1.63 1.96 2.37 3 3.96];
TdP=(T+273)./P;
p=polyfit(TdP,V,1);
R=p(1)/n
TdPplot=linspace(200,70,50)
Vplot=p(1)*TdPplot+p(2);
plot(TdP,V,'o',TdPplot,Vplot)
axis([50 220 0 1])
xlabel('T/P (K/atm)')
ylabel('V (L)')
```



Command Window:

```
>> format long
R =
   0.082156823269242
```

(Units of R: L-atm/mol-K)



Chapter 9
Solved Problems

Problem 1

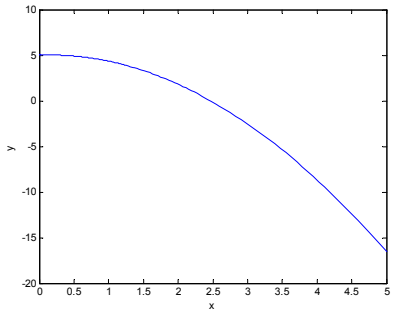
Script file:

```
F=@ (x) exp(0.3*x)-x^2+4;
fplot(F,[0 5])
xlabel('x')
ylabel('y')
r=fzero(F,3)
```

Command Window:

```
r =
    2.4693
```

Figure:



Problem 2

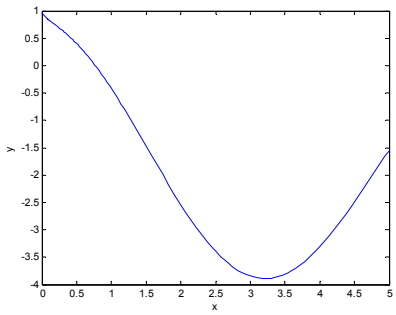
Script file:

```
F=@ (x) 2*cos(x)-0.5*sqrt(x)-1;
fplot(F,[0 5])
xlabel('x')
ylabel('y')
r=fzero(F,3)
```

Command Window:

```
r =
    0.7683
```

Figure:



Problem 3

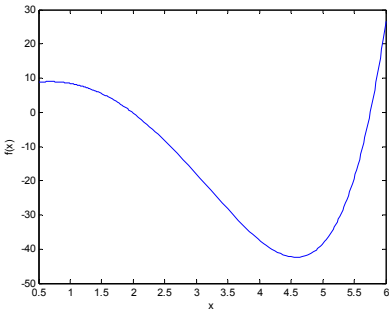
Script file:

```
F=@ (x) x^3-5*x^2.5+exp(0.9*x)+4*(x+1)+2;
fplot(F,[0.5 6])
xlabel('x')
ylabel('f(x)')
x1=fzero(F,2)
x2=fzero(F,5)
```

Command Window:

```
x1 =
    1.9830
x2 =
    5.7555
```

Figure:



Problem 4

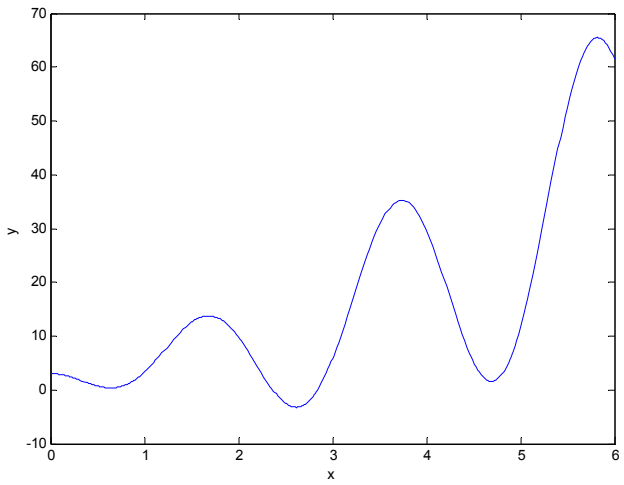
Script file:

```
F=@ (x) x^2-5*x*sin(3*x)+3;
fplot(F,[0 6])
xlabel('x')
ylabel('y')
r1=fzero(F,2)
r2=fzero(F,3)
```

Command Window:

```
r1 =
    2.3656
r2 =
    2.8435
```

Figure:



Problem 5

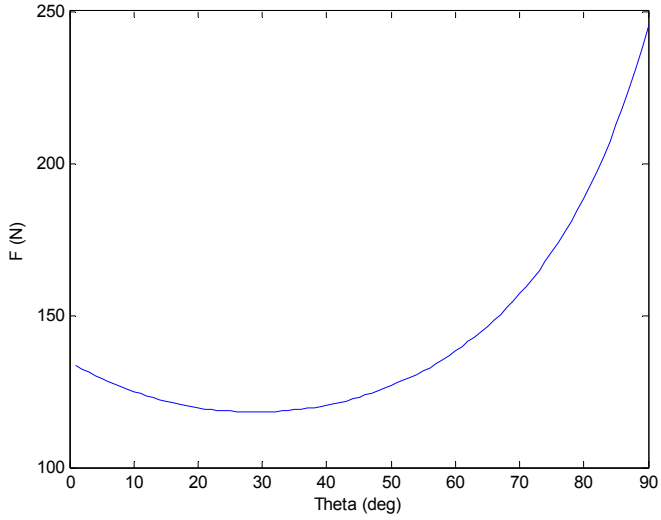
Script file:

```
mu=0.55; g=9.81; m=25;
Fun=@ (x) mu*m*g./(cosd(x)+mu*sind(x));
x=1:90;
F=Fun(x);
plot(x,F)
xlabel('Theta (deg)')
ylabel('F (N)')
Fs=150;
Funs=@ (x) mu*m*g./(cosd(x)+mu*sind(x))-Fs;
ths=fzero(Funs,70)
```

Command Window:

```
ths =
   66.8176
```

Figure:



Problem 6

Script file:

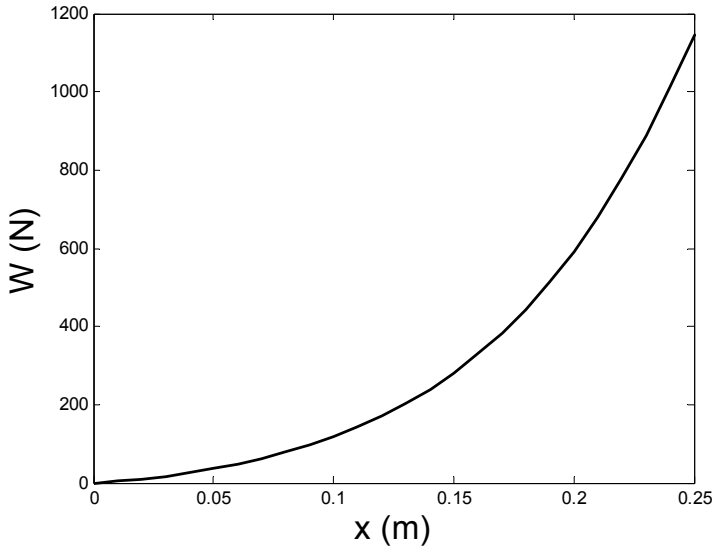
```
a=0.22; b=0.08; K=1600; W=400; K2=100000;
L0=sqrt(a^2+b^2);
L=@ (x) sqrt(a^2+(b+x).^2);
F=@ (x) (L(x)-L0)*K+(L(x)-L0).^3*K2;
xp=0:0.01:0.25;
Fp=2*F(xp).*(b+xp)./L(xp);
plot(xp,Fp,'k','linewidth',2)
xlabel('x (m)','fontsize',18)
ylabel('W (N)','fontsize',18)
f=@(x) 2*F(x).*(b+x)./L(x)-W;
d=fzero(f,0.1)
```

Command Window:

```
d =
    0.1729
```

Answer: $x = 0.1729$m.

Figure:



Problem 7

Script file:

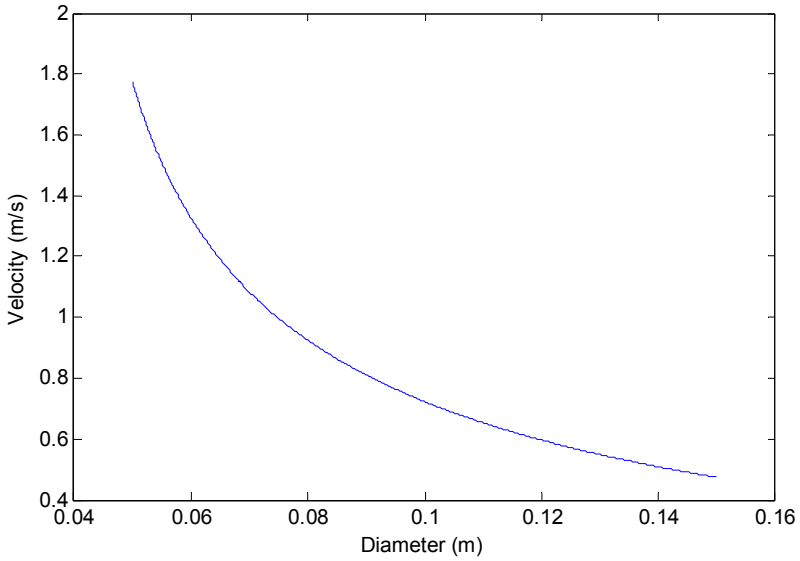
```
M=0.1; g=9.81; C=1;row=1000; beta=10; tet=10;
%d=0.1
F=@(x) sqrt(16*M*g./(pi*C*row*x.^2))./(sqrt(1-
(8*M*tand(beta)^2)./(pi*x.^3*C*row*sind(tet))))-0.8;
dia=fzero(F,0.12)
Fp=@(x) sqrt(16*M*g./(pi*C*row*x.^2))./(sqrt(1-
(8*M*tand(beta)^2)./(pi*x.^3*C*row*sind(tet))));
xp=0.05:0.0001:0.15;
Velp=Fp(xp);
plot(xp,Velp)
xlabel('Diameter (m)')
ylabel('Velocity (m/s)')
```

Command Window:

```
dia =
    0.0911
```

Answer: *diameter* = 0.0911m.

Figure:



Problem 8

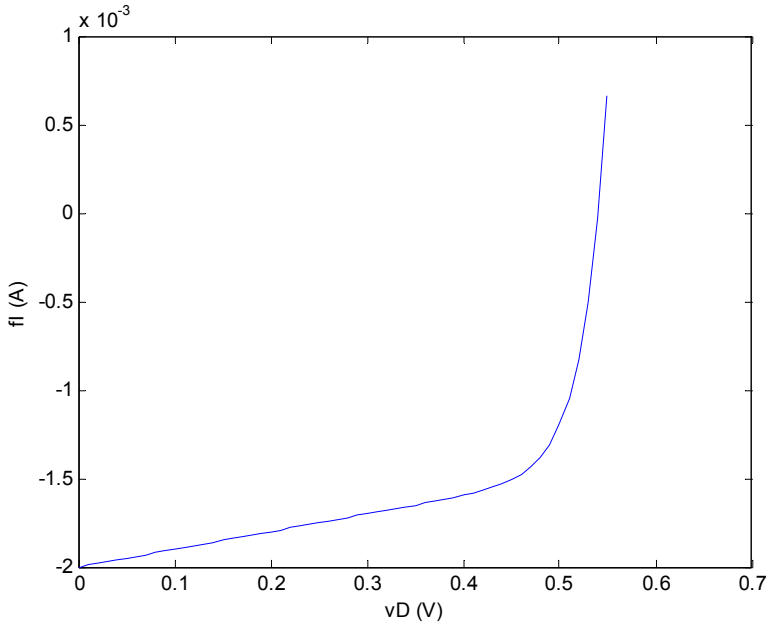
Script File:

```
Is=1E-12; q=1.6E-19; k=1.38E-23;
Vs=2; R=1000;
T=297;
fI=@(vD) Is*(exp((vD*q)./(k*T))-1)-(Vs-vD)./R;
vD=0:0.01:0.55;
Ip=fI(vD);
plot(vD,Ip)
xlabel('vD (V)')
ylabel('fI (A)')
vDSol=fzero(fI, 0.5)
```

Command Window:

```
vDSol =
   0.5405
```

Figure:



Problem 9

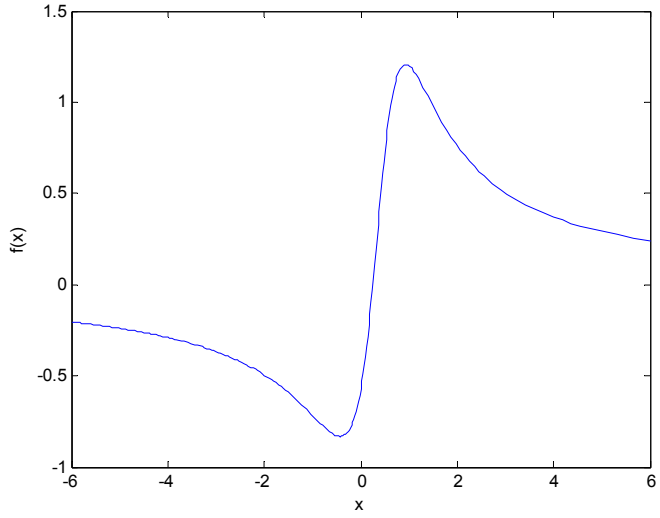
Script file:

```
F = @ (x) 3*(x-0.25)/(1+3.5*(0.8*x-0.3)^2);
Finv = @ (x) -3*(x-0.25)/(1+3.5*(0.8*x-0.3)^2);
fplot(F,[-6 6])
xlabel('x')
ylabel('f(x)')
[xmin, fmin]=fminbnd(F,-2,0)
[xmmax, fmax]=fminbnd(Finv,0,3))
```

Command Window:

```
xmin =
   -0.4298
fmin =
   -0.8321
xmmax =
    0.9297
fmax =
   -1.2071
```

Figure:



Problem 10

Script file:

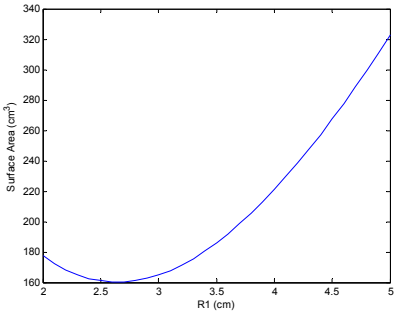
```
V=250;
R1=2:0.1:5;
R2=2*R1;
h=3*V./(pi*(R1.^2+R2.^2+R1.*R2));
S=pi*(R1+R2).*sqrt((R2-R1).^2+h.^2)+pi*R1.^2;
plot(R1,S)
xlabel('R1 (cm)')
ylabel('Surface Area (cm^3)')
SUR=@ (x) pi*(x+2*x)*sqrt((2*x-x)^2+(3*V/
(pi*(x^2+(2*x).^2+x.*2*x))).^2)+pi*x.^2;
R1min=fminbnd(SUR,1,5)
R2min=2*R1min
H=3*V./(pi*(R1min.^2+R2min.^2+R1min.*R2min))
```

Command Window:

```
R1min =
    2.6448
R2min =
    5.2897
H =
    4.8755
```

Answer: $R_1 = 2.6448$ cm, $R_2 = 5.2897$ cm, and $h = 4.8755$ cm.

Figure:



Problem 11

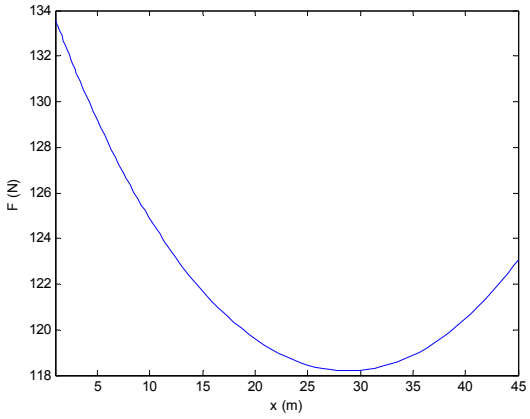
Script file:

```
mu=0.55; g=9.81; m=25;
Fun=@ (x) mu*m*g./(cosd(x)+mu*sind(x));
fplot(Fun,[1,45])
xlabel('x (m)')
ylabel('F (N)')
[xmin Fmin]=fminbnd(Fun, 10, 30)
```

Command Window:

```
xmin =
   28.8108
Fmin =
  118.1906
```

Figure:



Problem 12

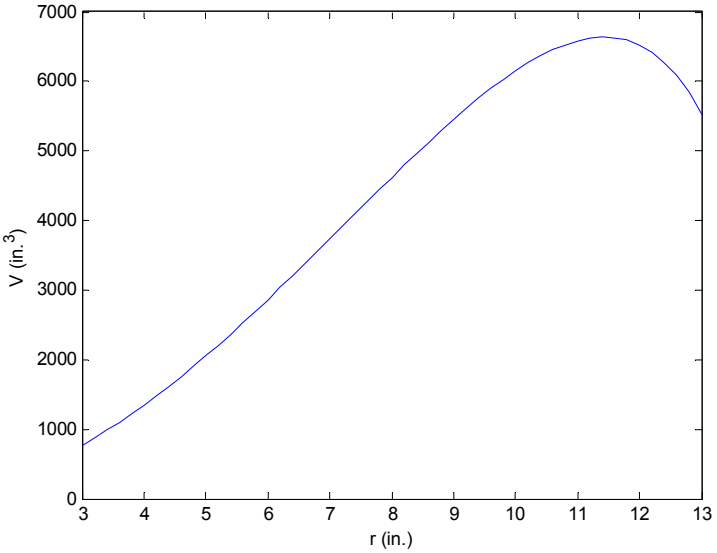
Script file:

```
R=14;
r=3:0.2:13;
h=2*sqrt(R^2-r.^2);
V=pi*r.^2.*h;
plot(r,V)
xlabel('r (in.)')
ylabel('V (in.^3)')
VOL=@ (x) -pi*x^2*2*sqrt(R^2-x^2);
rVmax=fminbnd(VOL,10,13)
hVmax=2*sqrt(R^2-rVmax^2)
```

Command Window:

```
rVmax =
   11.4309
hVmax =
   16.1658
```

Figure:



Problem 13

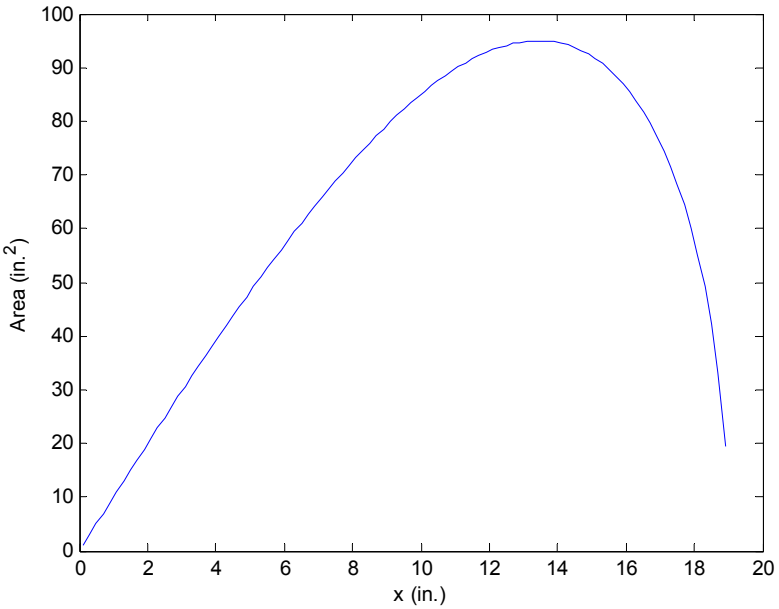
Script file:

```
F=@ (x) x.*sqrt(5^2*(1-x.^2/19^2));
Fneg=@ (x) -x.*sqrt(5^2*(1-x.^2/19^2));
x=0.1:0.2:18.9;
Ap=2*F(x);
plot(x,Ap)
xlabel('x (in.)')
ylabel('Area (in.^2)')
[xAmax]=fminbnd(Fneg,12,16);
aAmax=2*xAmax
bAmax=2*sqrt(5^2*(1-xAmax.^2/19^2))
```

Command Window:

```
aAmax =
   26.8701
bAmax =
    7.0711
```

Figure:



Problem 14

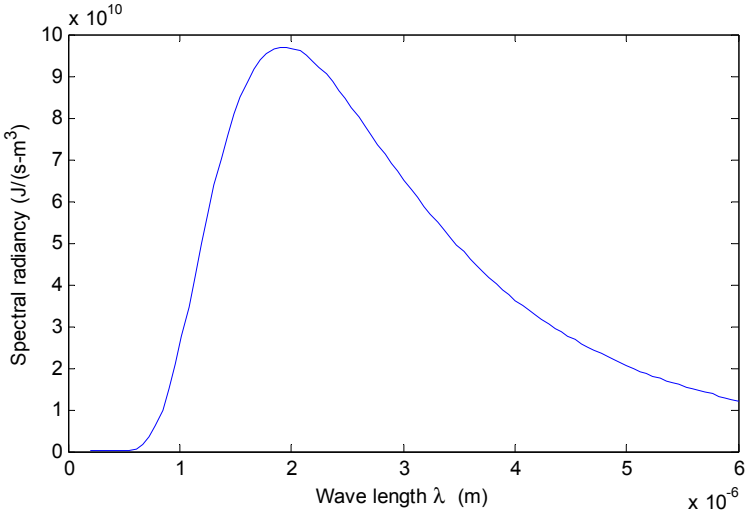
Script file:

```
c=3.0e8; h=6.63e-34; k=1.38e-23; T=1500;
KA=2*pi*c^2*h;  KB=h*c/(k*T);
lmda=linspace(0.2e-6,6e-6,100);
R=(2*pi*c^2*h)./(lmda.^5.*(exp(h*c./(lmda*k*T))-1));
plot(lmda,R)
xlabel('Wave length \lambda  (m)')
ylabel('Spectral radiancy (J/(s-m^3)')
[lmdamax rmax]=fminbnd('(-2*pi*(3.0e8)^2*6.63e-34)/
(x^5*(exp((6.63e-34*3.0e8)/(x*1.38e-23*1500))-1))',1.9e-
6,2e-6)
```

Command Window:

```
lmdamax =
  1.9382e-006
rmax =
 -9.7046e+010
```

Figure:



Answer: Max *R* at λ = 1.9382e-006 m

Problem 15

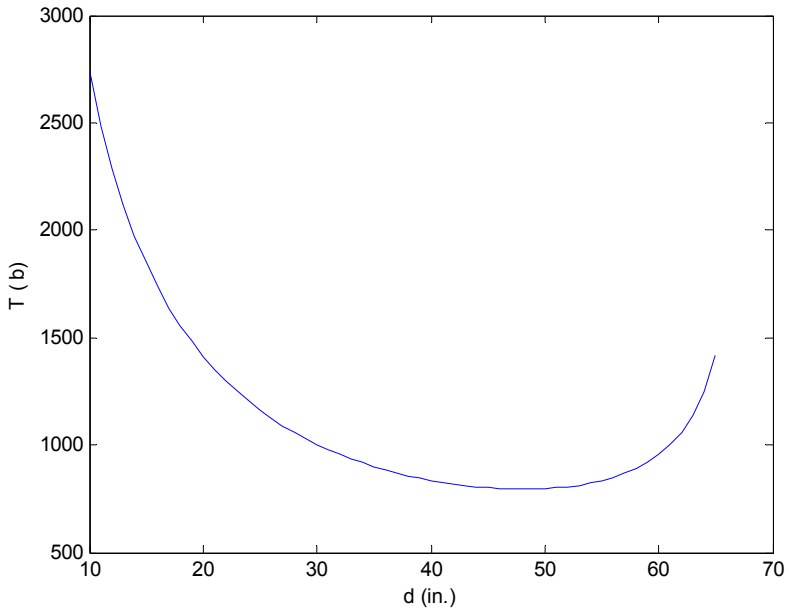
Script file:

```
L=108; Lc=68; W=250;
F= @ (d) W*L*Lc./(sqrt(Lc^2-d.^2).*d);
d=10:65;
T=F(d);
plot(d,T)
xlabel('d (in.)')
ylabel('T (lb)')
[dTmin]=fminbnd(F,40,60)
```

Command Window:

```
dTmin =
  48.0833
```

Figure:



Problem 16

Script file:

```
clear, clc
disp('part (a)')
Fa= @ (x) 0.5*x.^3./(1+2*sqrt(x));
qa=quadl(Fa,2,10)
disp('part (b)')
Fb= @ (x) 0.5+cos(1.2*x)./(x+2).^2;
qa=quadl(Fb,0,9)
```

Command Window:

```
part (a)
qa =
  190.2484
part (b)
qa =
    4.5757
```

Problem 17

Script file:

```
clear, clc
disp('part (a)')
Fa= @ (x) exp(x)./x.^3;
qa=quadl(Fa,1,8)
disp('part (b)')
Fb= @ (x) cos(x).*exp(sqrt(x));
qa=quadl(Fb,0,4*pi)
```

Command Window:

```
part (a)
qa =
   12.3621
part (b)
qa =
    3.5934
```

Problem 18

Script file:

```
t=[0:7];
v=[0 14 39 69 95 114 129 139];
vfps=v*5280/3600;
xft=trapz(t,vfps)
```

Command Window:

```
xft =
  776.6000
```

Problem 19

$$\frac{df(x)}{dx} = -\frac{68.8}{99.7}\sinh\left(\frac{x}{99.7}\right)$$

Script file:

```
a=299.25;
F=@ (x) sqrt(1+(-68.8/99.7*sinh(x/99.7)).^2);
Larch=quadl(F,-a,a)
```

Command Window:

```
Larch =
   1.4800e+03
```

Problem 20

Script file:

```
vmax=80; R=0.25; n=7;
F=@ (x) 2*pi*vmax*(1-x/R).^(1/n).*x;
Q=quad(F,0,R)
```

Command Window:

```
Q =
   12.8282
```

Problem 21

Script file:

```
seg=300e-6; eps=8.85e-12; z=0.05;
K=seg*z/(4*eps);
E=K*quad('(0.05^2+r.^2).^(-3/2)*2.*r',0,0.06)
```

Command Window:

```
E =
  6.0986e+006
```

Answer: E = 6.0986e+006 N/C.

Problem 22

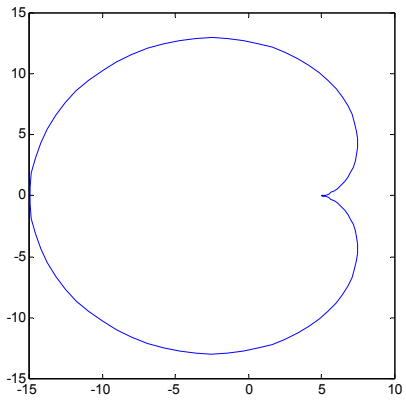
Script file:

```
clear, clc
t=linspace(0,2*pi,100);
b=5;
x=2*b*cos(t)-b*cos(2*t);
y=2*b*sin(t)-b*sin(2*t);
plot (x,y)
axis square
xd=-2*b*sin(t)+2*b*sin(2*t);
yd=2*b*cos(t)-2*b*sin(2*t);
F= @ (x) sqrt((-2*b*sin(x)+2*b*sin(2*x)).^2+(2*b*cos(x)-
2*b*sin(2*x)).^2);
L=quadl(F,0,2*pi)
```

Command Window:

```
L =
   80.6566
```

Figure:



Problem 23

Command Window:

```
>> U=quad('500*6371000^2*9.81./(6371000+x).^2',0,800000)
U =
  3.4862e+009
```

Problem 24

Script file:

```
x=0:40:440;
d=[0 40 96 140 147 121 117 139 140 62 18 0];
A=trapz(x,d)
```

Command Window:

```
A =
       40800
```

Problem 25

The coordinates of the border y at 50-mile increments of x are as follows:

x	0	50	100	150	200	250	300	350	400	450	500
above	0	0	0	0	0	300	300	300	175	150	125
below	0	50	100	175	200	150	150	200	300	375	400

x	550	600	650	700	750
above	125	125	125	125	0
below	400	250	225	150	150

Script file:

```
clear, clc
x=0:50:750;
y_above=[0 0 0 0 0 300 300 300 175 150 125 125 125 125 125
0];
y_below=[0 50 100 175 200 150 150 200 300 375 400 400 250 225
150 150];
A=trapz(x,y_above)+trapz(x,y_below)
```

Command Window:

```
A =
      252500
```

Answer: Area is 252,500 square miles. (Actual area 261,797 square miles)

Problem 26

Script file:

```
a=40; b=15;
F=@ (x) x.*sqrt(1-(x.^2/a^2));
A=pi*a*b/2;
My=2*b*quad(F,0,a);
xcent=My/A
```

Command Window:

```
xcent =
   16.9765
```

Problem 27

Script file:

```
a=5.9065e9; b=5.7208e9;
k=sqrt(a^2-b^2)/a;
F=@ (x) sqrt(1-k^2*sin(x).^2);
q=quad(F,0, pi/2);
P=4*a*q;
% Number of hours in 248 years.
hrs=24*365*248
vAve=P/hrs
```

Command Window:

```
vAve =
  1.6815e+004
```

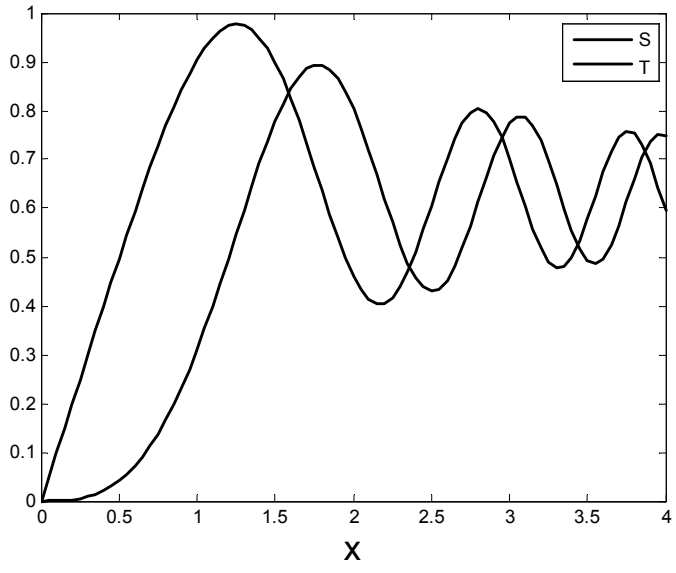
Answer: Average speed 1.6815e+004 km/h

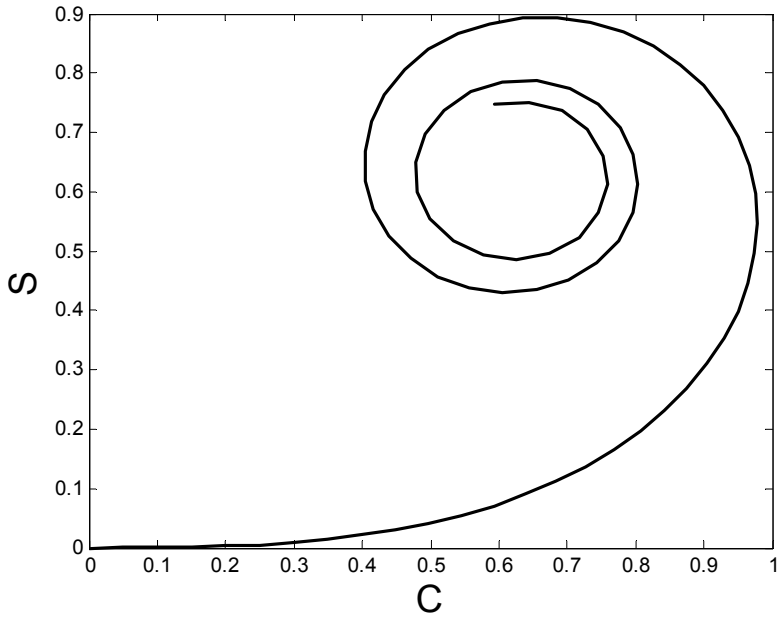
Problem 28

Script file:

```
si=@(x) sin(x.^2);
co=@ (x) cos(x.^2);
x=0:0.05:4;
n=length(x);
for i=1:n
    S(i)=quad(si,0,x(i));
    C(i)=quad(co,0,x(i));
end
plot(x,S,'k-',x,C,'k--','linewidth',2)
%legend('S','T','fontsize',18)
legend('S','T')
xlabel('x','fontsize',18)
figure
plot(C,S,'k','linewidth',2)
xlabel('C','fontsize',18)
ylabel('S','fontsize',18)
```

Figures:



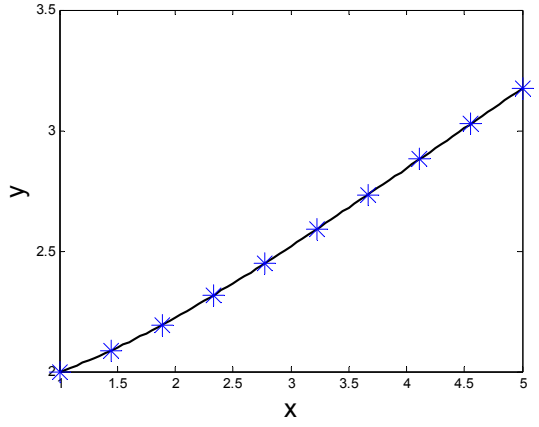

0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
S
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
C

Problem 29

Script file:

```
a=1; b=5;
ya=2;
F=@(x,y) 2*x/(3*y^2);
[x y]=ode45(F,[a:0.05:b],ya);
plot(x,y,'k','linewidth',2)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
xp=linspace(a,b,10);
Fsol=@ (x) (x.^2+7).^(1/3);
yp=Fsol(xp);
hold on
plot(xp,yp,'*','markersize',15)
hold off
```

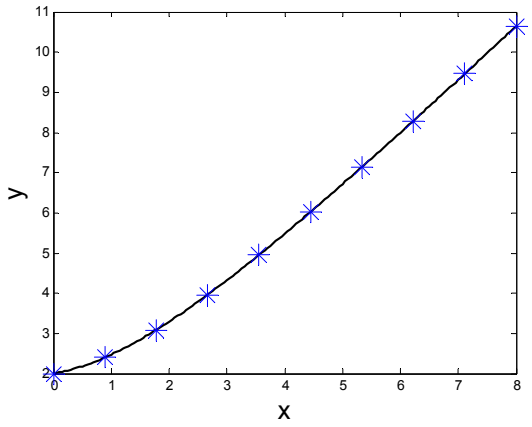
Figure:



Problem 30

Script file:

```
F=@(x,y) (2*x+1)/(y+2);
[x y]=ode45(F,[0:0.05:8],2);
plot(x,y,'k','linewidth',2)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
xp=linspace(0,8,10);
Fsol=@ (x) sqrt(2*x.^2+2*x+16)-2;
yp=Fsol(xp);
hold on
plot(xp,yp,'*','markersize',15)
hold off
```

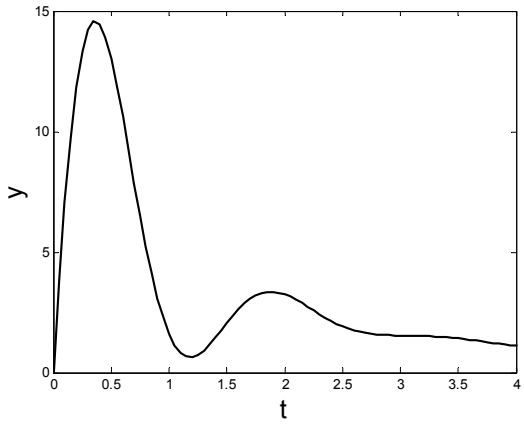


Problem 31

Script file:

```
a=0; b=4;
ya=0;
F=@(t,y) 80*exp(-1.6*t)*cos(4*t)-0.4*y;
[x y]=ode45(F,[a:0.05:b],ya);
plot(x,y,'k','linewidth',2)
xlabel('t','fontsize',18)
ylabel('y','fontsize',18)
```

Figure:

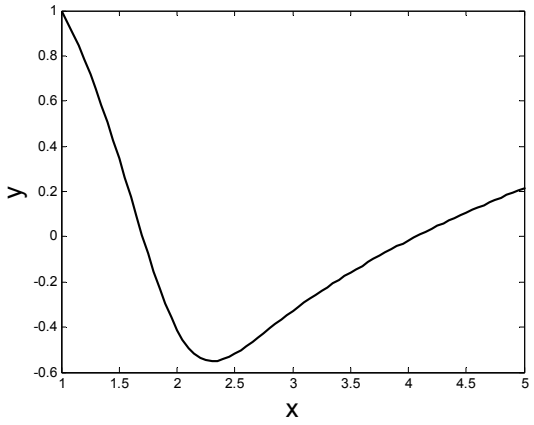


Problem 32

Script file:

```
F=@(x,y) -x^2+x^3*exp(-y)/4;
[x y]=ode45(F,[1:0.05:5],1);
plot(x,y,'k','linewidth',2)
xlabel('x','fontsize',18)
ylabel('y','fontsize',18)
```

Figure:

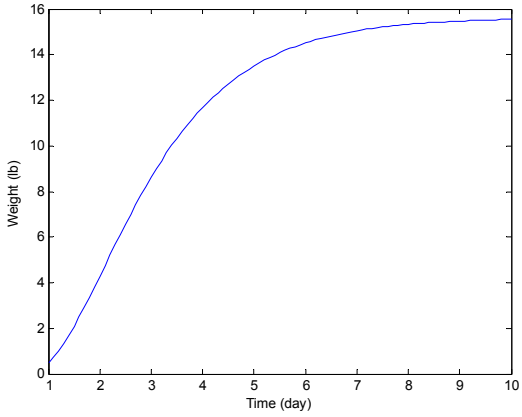


Problem 33

Script file:

```
clear, clc
a=5; b=2;
dwdt=@ (t,w) a*w^(2/3)-b*w;
wa=0.5;
[t w]=ode45(dwdt,[1:0.1:10],wa);
plot(t,w)
xlabel('Time (day)')
ylabel('Weight (lb)')
```

Figure:



Problem 34

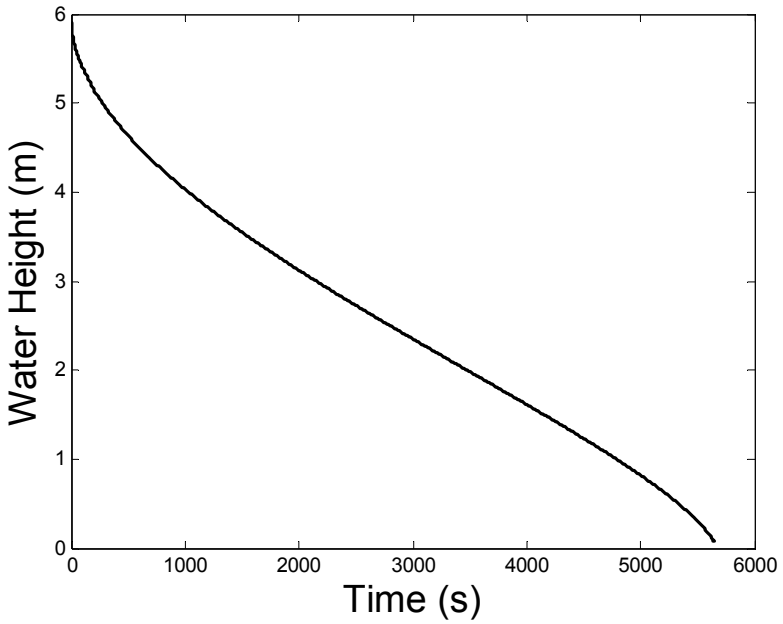
Script file:

```
a=1.5; b=4; c=3; g=9.81; r=0.025;
rsq=r^2;
dhdt=@ (t,h) sqrt(2*g*h)*rsq/(a*b*(-1+(h-c)^2/c^2));
[t y]=ode45(dhdt,[0:0.1:5642.5],5.9);
plot(t,y,'k','linewidth',2)
xlabel('Time (s)','fontsize',18)
ylabel('Water Height (m)','fontsize',18)
tlast=t(length(t))
ylast=y(length(t))
```

Command Window:

```
tlast =
  5.6425e+003
ylast =
    0.0714
```

Figure:



Problem 35

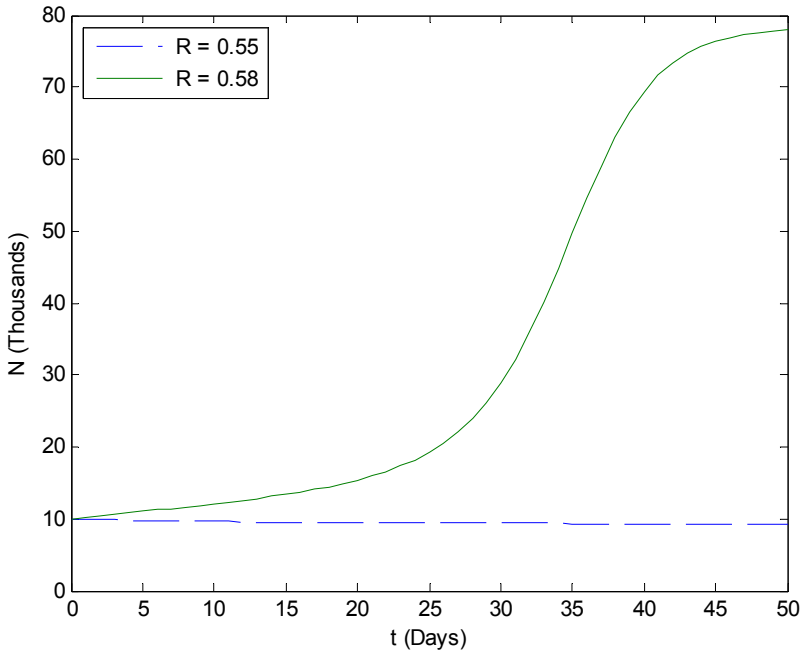
User-defined function:

```
function dNdt=ODEHW9_35_5ed(t,N)
global R
C=100; Nc=10; r=10;
dNdt=R*N*(1-N/C)-r*N^2/(Nc^2+N^2);
```

Script File:

```
global R
R=0.55;
[t1 N1]=ode45(@ODEHW9_35_5ed,[0:1:50],10);
R=0.58;
[t2 N2]=ode45(@ODEHW9_35_5ed,[0:1:50],10);
plot(t1,N1,'--',t2,N2,'-')
xlabel('t (Days)')
ylabel('N (Thousands)')
legend(' R = 0.55',' R = 0.58',2)
```

Figure:

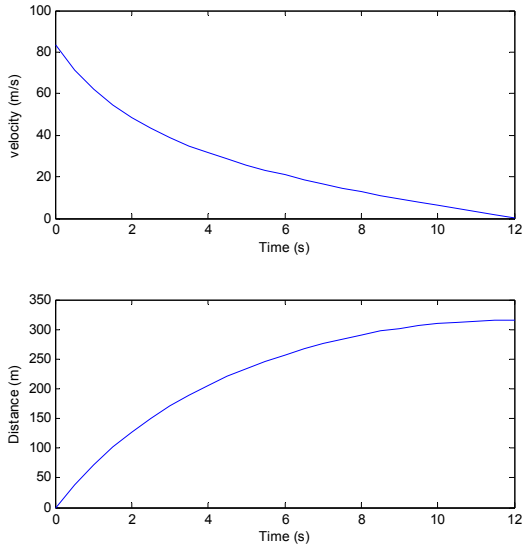


Problem 36

Script file:

```
dvdt= @ (t,v)-0.0035*v^2-3;
[t v]=ode45(dvdt,[0:0.5:12],83.33);
subplot(2,1,1)
plot(t,v)
xlabel('Time (s)')
ylabel('velocity (m/s)')
n=length(t);
x(1)=0;
for i=2:n
    ti=t(1:i);
    vi=v(1:i);
x(i)=trapz(ti,vi);
end
subplot(2,1,2)
plot(t,x)
xlabel('Time (s)')
ylabel('Distance (m)')
```

Figure:

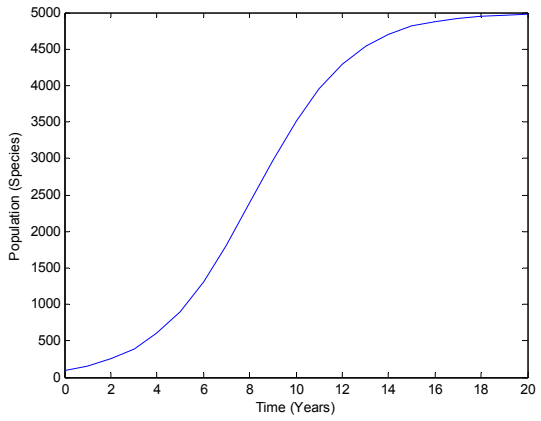


Problem 37

Script file:

```
mu=0.000095; Nm=5000;
dNdt=@ (t,N) mu*N*(Nm-N);
[t N]=ode45(dNdt,[0:20],100);
plot(t,N)
xlabel('Time (Years)')
ylabel('Population (Species)')
```

Figure:

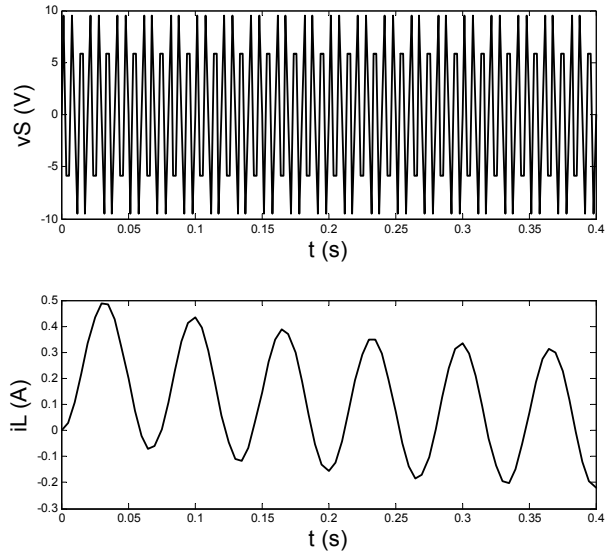


Problem 38

(*a*)
Script file:

```
R=1.80; L=0.4;
FvS=@ (t) 10*sin(3*pi*t/0.01);
dydt=@ (t,y) (10*sin(3*pi*t/0.1)-y*R)/L;
[t iL]=ode45(dydt,[0:0.005:0.4],0);
tp=0:0.002:0.4;
vs=FvS(tp);
subplot(2,1,1)
plot(tp,vs,'k','linewidth',2)
xlabel('t (s)','fontsize',18)
ylabel('vS (V)','fontsize',18)
subplot(2,1,2)
plot(t,iL,'k','linewidth',2)
xlabel('t (s)','fontsize',18)
ylabel('iL (A)','fontsize',18)
```

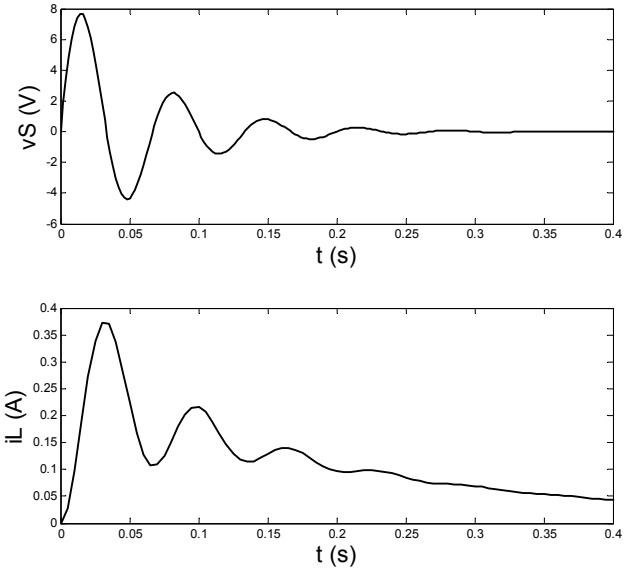
Figure:



(*b*)
Script file:

```
R=1.80; L=0.4;
FvS=@ (t) 10*exp(-t/0.06).*sin(3*pi*t/0.1);
dydt=@ (t,y) (10*exp(-t/0.06)*sin(3*pi*t/0.1)-y*R)/L;
[t iL]=ode45(dydt,[0:0.005:0.4],0);
tp=0:0.002:0.4;
vs=FvS(tp);
subplot(2,1,1)
plot(tp,vs,'k','linewidth',2)
xlabel('t (s)','fontsize',18)
ylabel('vS (V)','fontsize',18)
subplot(2,1,2)
plot(t,iL,'k','linewidth',2)
xlabel('t (s)','fontsize',18)
ylabel('iL (A)','fontsize',18)
```

Figure:

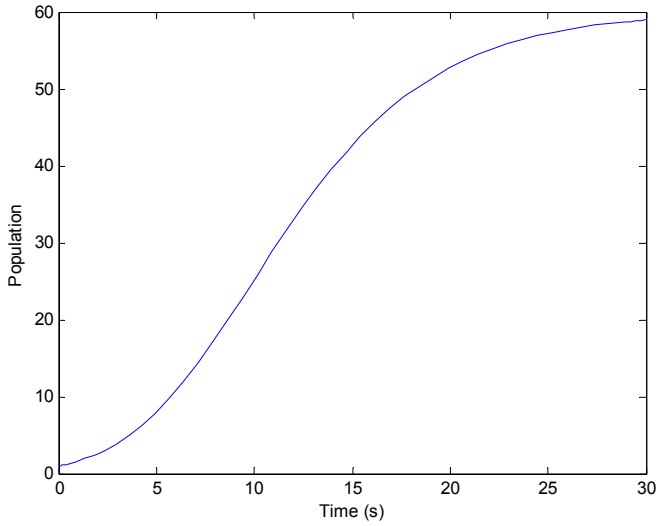


Problem 39

Script file:

```
a=0.8; k=60;
dNdt=@ (t,N) a*N*(1-(N/k)^0.25);
[t N]=ode45(dNdt,[0 30],1);
plot(t,N)
xlabel('Time (s)')
ylabel('Population')
```

Figure:



Problem 40

Script file:

```
m=5; g=9.81;
dvdt=@ (t,v) -g+0.05*v^2/m;
[t v]=ode45(dvdt,[0:0.1:15],0);
plot(t,v)
xlabel('Time (s)')
ylabel('Velocity (m/s)')
```

Figure: