CHAPTER 2

2.1

```
A =
     1     2     3
     2     4     6
     3     2     1
A =
     1     2     3
     2     4     2
     3     6     1
A =
     1     2
     2     4
     3     6
A =
     1     4     2
     2     5     4
     3     7     6
A =
    12
```

2.2 **(a)**
```
y=(6*t.^3-3*t-4)./(8*sin(5*t))
```
(b)
```
y=(6*t-4)./(8*t)-pi/2*t
```

2.3
```
x=y.*(a+b*z).^1.8./(z.*(1-y))
```

2.4

(a)
```
ans =
     3
     4
```
(b)
```
y =
          0
    1.5000
          3
    4.5000
          6
```
(c)
```
ans =
     4
```

2.5
```
clc,clf,format compact
x=[0:1/256:2];
y=1./((x-0.3).^2+0.01)+1./((x-0.9).^2+0.04)-6;
plot(x,y)
```

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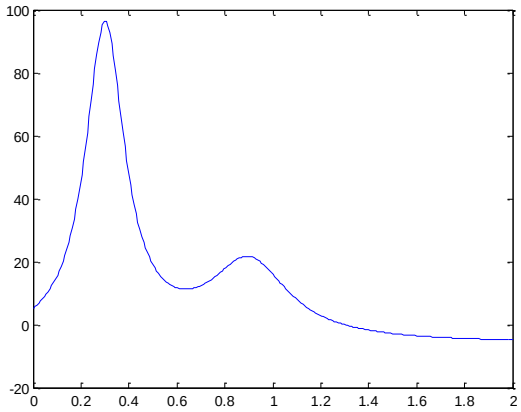

2.6 (a)

```
>> t = linspace(4,34,6)
t =
     4    10    16    22    28    34
```

(b)

```
>> x = linspace(-4,2,7)
x =
    -4    -3    -2    -1     0     1     2
```

2.7 (a)

```
>> v = -2:0.5:1.5
v =
   -2.0000 -1.5000 -1.0000 -0.5000       0  0.5000  1.0000
    1.5000
```

(b)

```
>> r = 8:-0.5:4.5
r =
    8.0000  7.5000  7.0000  6.5000  6.0000  5.5000  5.0000
    4.5000
```

2.8 The command `linspace(a,b,n)` is equivalent to the colon notation

```
>> a:(b-a)/(n-1):b
```

Test case:

```
>> a=-3;b=5;n=6;
>> linspace(a,b,n)
ans =
   -3.0000   -1.4000    0.2000    1.8000    3.4000    5.0000


>> a:(b-a)/(n-1):b
ans =
 -3.0000   -1.4000    0.2000    1.8000    3.4000    5.0000
```

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2.9 (a)

```
>> A=[3 2 1;0:0.5:1;linspace(6, 8, 3)]
A =
    3.0000    2.0000    1.0000
         0    0.5000    1.0000
    6.0000    7.0000    8.0000
```

(b)

```
>> C=A(2,:)*A(:,3)
C =
   8.5
```

2.10

```
format short g
a=2;b=5;
x=0:pi/40:pi/2;
y=b*exp(-a*x).*sin(b*x).*(0.012*x.^4-
0.15*x.^3+0.075*x.^2+2.5*x);
z=y.^2;
w = [x' y' z']
plot(x,y,'-.pr','LineWidth',1.5,'MarkerSize',14,...
    'MarkerEdgeColor','r','MarkerFaceColor','w')
hold on
plot(x,z,'-sb','MarkerFaceColor','g')
xlabel('x'); ylabel('y, z'); legend('y','z')
hold off
```

Output:

```
w =
            0            0            0
      0.07854      0.32172      0.10351
      0.15708       1.0174       1.0351
      0.23562        1.705       2.9071
      0.31416       2.1027       4.4212
       0.3927       2.0735       4.2996
      0.47124       1.6252       2.6411
      0.54978      0.87506      0.76573
      0.62832   2.7275e-16   7.4392e-32
      0.70686     -0.81663      0.66689
       0.7854       -1.427       2.0365
      0.86394      -1.7446       3.0437
      0.94248      -1.7512       3.0667
        1.021      -1.4891       2.2173
       1.0996      -1.0421       1.0859
       1.1781     -0.51272      0.26288
       1.2566  -2.9683e-16    8.811e-32
       1.3352      0.41762       0.1744
       1.4137      0.69202       0.4789
       1.4923      0.80787      0.65265
       1.5708      0.77866      0.60631
```

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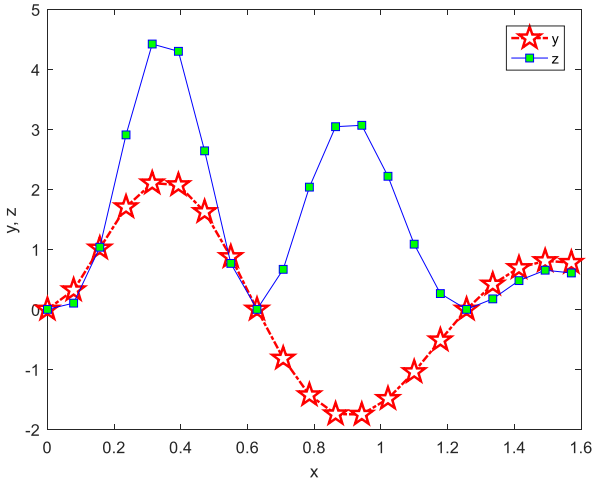
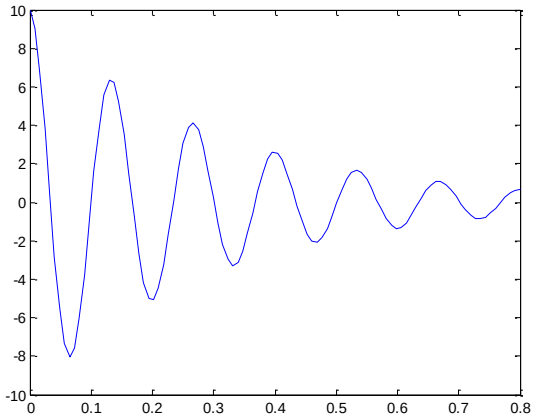


2.11

```
>> q0 = 10;R = 60;L = 9;C = 0.00005;
>> t = linspace(0,.8);
>> q = q0*exp(-R*t/(2*L)).*cos(sqrt(1/(L*C)-(R/(2*L))^2)*t);
>> plot(t,q)
```



2.12

```
>> z = linspace(-5,5);
>> f = 1/sqrt(2*pi)*exp(-z.^2/2);
>> plot(z,f)
>> xlabel('z')
>> ylabel('frequency')
```

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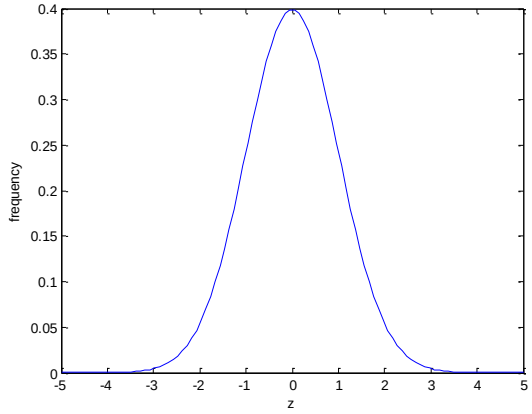
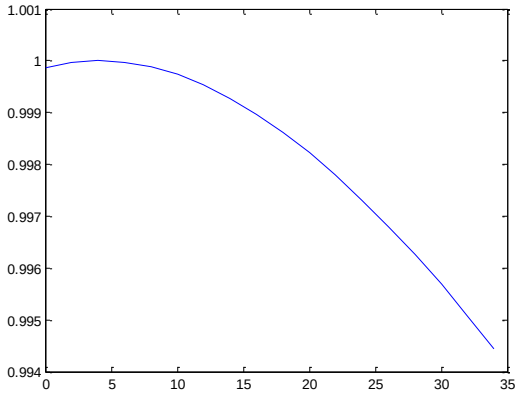


2.13

```
>> F = [14 18 8 9 13];
>> x = [0.013 0.020 0.009 0.010 0.012];
>> k = F./x

k =
  1.0e+003 *
    1.0769    0.9000    0.8889    0.9000    1.0833

>> U = .5*k.*x.^2

U =
    0.0910    0.1800    0.0360    0.0450    0.0780

>> max(U)

ans =
    0.1800
```

2.14

```
>> TF = 32:3.6:93.2;
>> TC = 5/9*(TF-32);
>> rho = 5.5289e-8*TC.^3-8.5016e-6*TC.^2+6.5622e-5*TC+0.99987;
>> plot(TC,rho)
```



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2.15 Script:

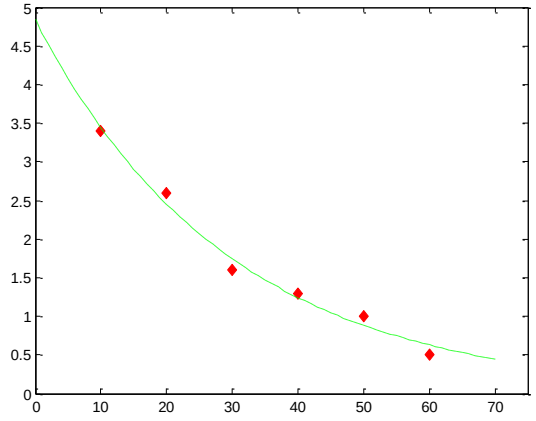
```
clear, clc
format compact
A = [.035 .0001 10 2;
0.02 0.0002 8 1;
0.015 0.001 20 1.5;
0.03 0.0007 24 3;
0.022 0.0003 15 2.5]
U =
sqrt(A(:,2))./A(:,1).*(A(:,3).*A(:,4)./(A(:,3)+2*A(:,4))).^(2/3)
```

Results:

```
A =
         0.035        0.0001            10             2
          0.02        0.0002             8             1
         0.015         0.001            20           1.5
          0.03        0.0007            24             3
         0.022        0.0003            15           2.5
U =
       0.36241
       0.60937
        2.5167
        1.5809
        1.1971
```

2.16

```
clear, clc
t = 10:10:60;
c = [3.4 2.6 1.6 1.3 1.0 0.5];
tf = 0:70;
cf = 4.84*exp(-0.034*tf);
plot(t,c,'d','MarkerEdgeColor','r','MarkerFaceColor','r')
hold on
plot(tf,cf,'--g')
xlim([0 75])
hold off
```



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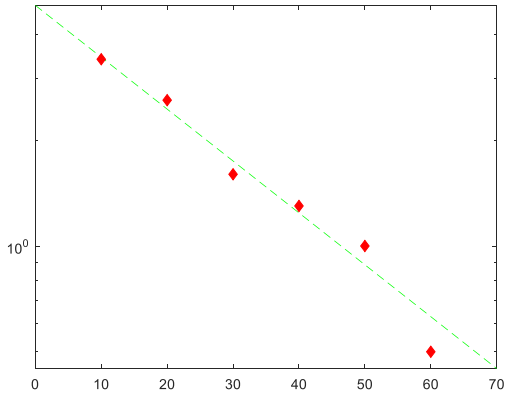
2.17

```
clear, clc
t = 10:10:60;
c = [3.4 2.6 1.6 1.3 1.0 0.5];
tf = 0:70;
cf = 4.84*exp(-0.034*tf);
plot(t,c,'d','MarkerEdgeColor','r','MarkerFaceColor','r')
hold on
plot(tf,cf,'--g')
xlim([0 75])
hold off
```

```
clear, clc
t = 10:10:60;
c = [3.4 2.6 1.6 1.3 1.0 0.5];
tf = 0:70;
cf = 4.84*exp(-0.034*tf);
semilogy(tf,cf,'--
g',t,c,'d','MarkerEdgeColor','r','MarkerFaceColor','r')
```



The result is a straight line. The reason for this outcome can be understood by taking the natural (Naperian or base-e) logarithm of the function to give,

$$\ln c = \ln 4.84 + \ln e^{-0.034t}$$

or because $\ln e^{-0.034t} = -0.034t$,

$$\ln c = \ln 4.84 - 0.034t$$

Thus, on a semi-log plot, the relationship is a straight line with an intercept of ln 4.84 and a slope of –0.034.

2.18 Script:

```
clear, clc
format compact
v = 10:10:80;
```

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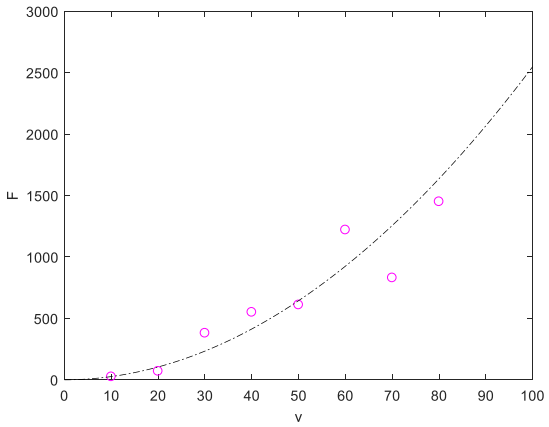
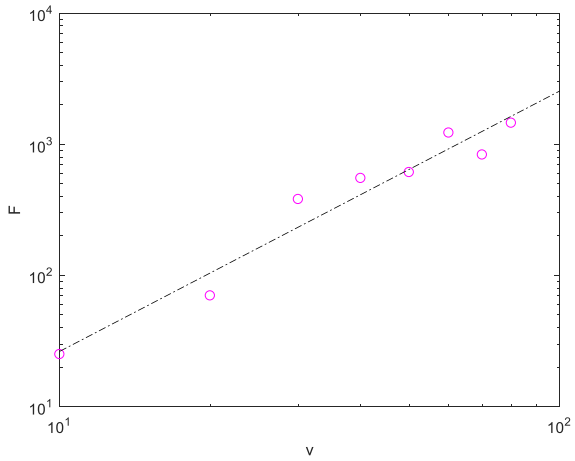
```
F = [25 70 380 550 610 1220 830 1450];
vf = 0:100;
Ff = 0.2741*vf.^1.9842;
plot(v,F,'om',vf,Ff,'-.k')
xlabel('v');ylabel('F');
```

Results:



2.19

```
clear, clc, format compact
v = 10:10:80;
F = [25 70 380 550 610 1220 830 1450];
vf=logspace(1,2);
Ff = 0.2741*vf.^1.9842;
loglog(v,F,'om',vf,Ff,'-.k')
xlabel('v');ylabel('F');
```



The result is a straight line. The reason for this outcome can be understood by taking the common logarithm of the function to give,

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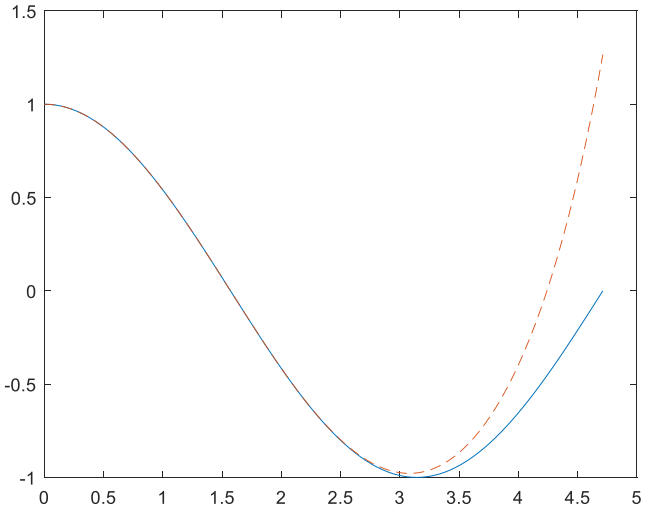
$$\log_{10} F = \log_{10} 0.2741 + 1.9842 \log_{10} v$$

Thus, on a log-log plot, the slope would be 1.9842 and the intercept would be $\log_{10}(0.2741)$.

2.20 Script:

```
clear, clc, format compact
x = linspace(0,3*pi/2);
c = cos(x);
cf = 1-x.^2/2+x.^4/factorial(4)-
x.^6/factorial(6)+x.^8/factorial(8);
plot(x,c,x,cf,'--')
```



2.21 (a)

```
>> m=[83.6 60.2 72.1 91.1 92.9 65.3 80.9];
>> vt=[53.4 48.5 50.9 55.7 54 47.7 51.1];
>> g=9.81; rho=1.223;
>> A=[0.455 0.402 0.452 0.486 0.531 0.475 0.487];
>> cd=g*m./vt.^2;
>> CD=2*cd/rho./A
CD =
    1.0337    1.0213    0.9877    0.9693    0.9625    0.9693
   1.0206
```

(b)

```
>> CDmin=min(CD),CDmax=max(CD),CDavg=mean(CD)
CDmin =
    0.9625
CDmax =
    1.0337
CDavg =
    0.9949
```

(c)

```
subplot(2,1,1);plot(m,A,'o')
ylabel('area (m^2)')
title('area versus mass')
```

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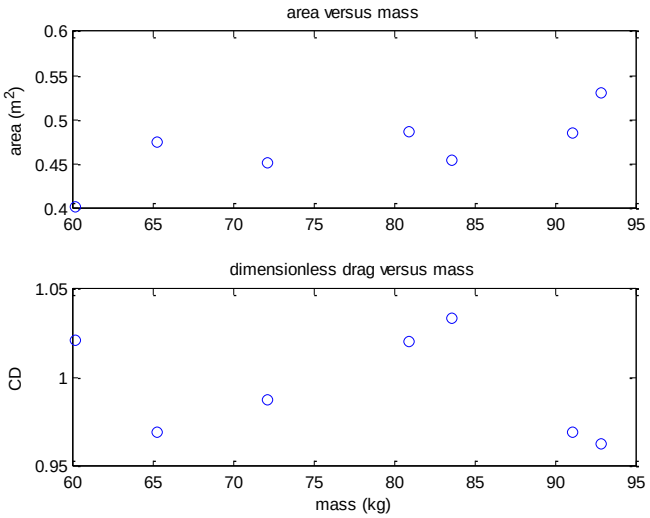
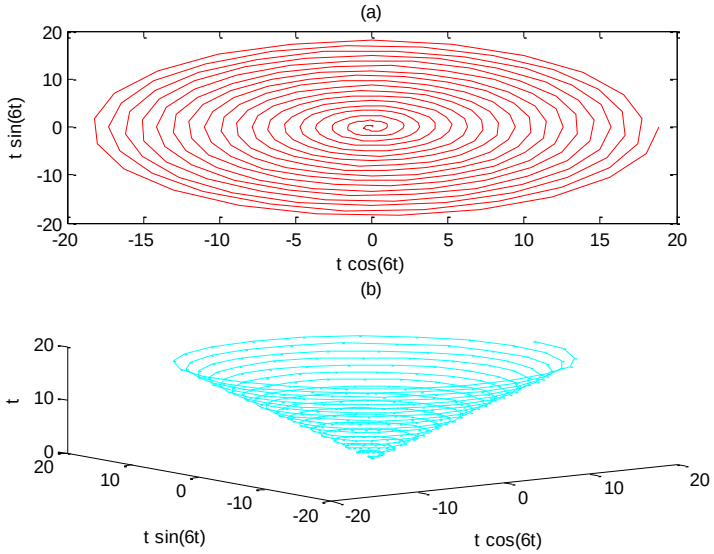
```
subplot(2,1,2);plot(m,CD,'o')
xlabel('mass (kg)')ylabel('CD')
title('dimensionless drag versus mass')
```



2.22 (a)

```
t = 0:pi/64:6*pi;
subplot(2,1,1);plot(t.*cos(6*t),t.*sin(6*t),'r')
title('(a)');xlabel('t cos(6t)');ylabel('t sin(6t)')
subplot(2,1,2);plot3(t.*cos(6*t),t.*sin(6*t),t,'c')
title('(b)');xlabel('t cos(6t)');ylabel('t sin(6t)');zlabel('t')
```



2.23 (a) Script:

```
clear, clc, format compact
x = 5; x ^ 3; y = 8 - x
Results:
y =
     3
```

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(b) Script:

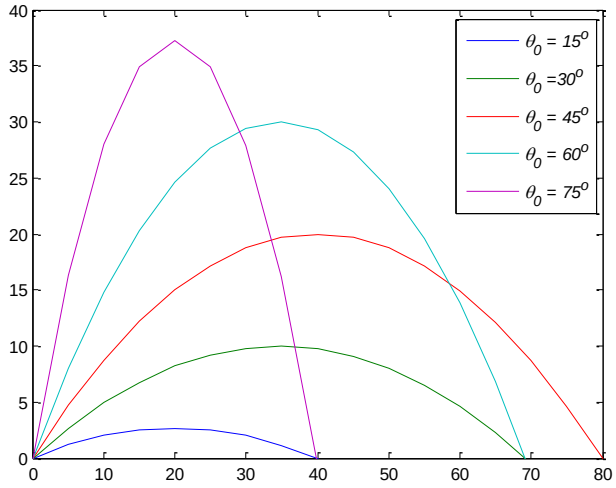
```
clear, clc, format compact
q = 4:2:12;
r = [7 8 4; 3 6 -5];
sum(q) * r(2, 3)
```

Results:

```
ans =
  -200
```

2.24

```
clear, clc, format compact
y0=0;v0=28;g=9.81;
x=0:5:80;
theta0=15*pi/180;
y1=tan(theta0)*x-g/(2*v0^2*cos(theta0)^2)*x.^2+y0;
theta0=30*pi/180;
y2=tan(theta0)*x-g/(2*v0^2*cos(theta0)^2)*x.^2+y0;
theta0=45*pi/180;
y3=tan(theta0)*x-g/(2*v0^2*cos(theta0)^2)*x.^2+y0;
theta0=60*pi/180;
y4=tan(theta0)*x-g/(2*v0^2*cos(theta0)^2)*x.^2+y0;
theta0=75*pi/180;
y5=tan(theta0)*x-g/(2*v0^2*cos(theta0)^2)*x.^2+y0;
y=[y1' y2' y3' y4' y5'];
plot(x,y);axis([0 80 0 40])
legend('\it\theta_0 = 15^o','\it\theta_0 =30^o', ...
    '\it\theta_0 = 45^o','\it\theta_0 = 60^o','\it\theta_0 =
   75^o')
```



2.25

```
clear, clc, format compact
R=8.314;E=1e5;A=7E16;
Ta=253:8:325;
k=A*exp(-E./(R*Ta));
subplot(1,2,1);plot(Ta,k,'g')
xlabel('Ta');ylabel('k');title('(a) k versus Ta')
subplot(1,2,2);semilogy(1./Ta,k,'r')
```

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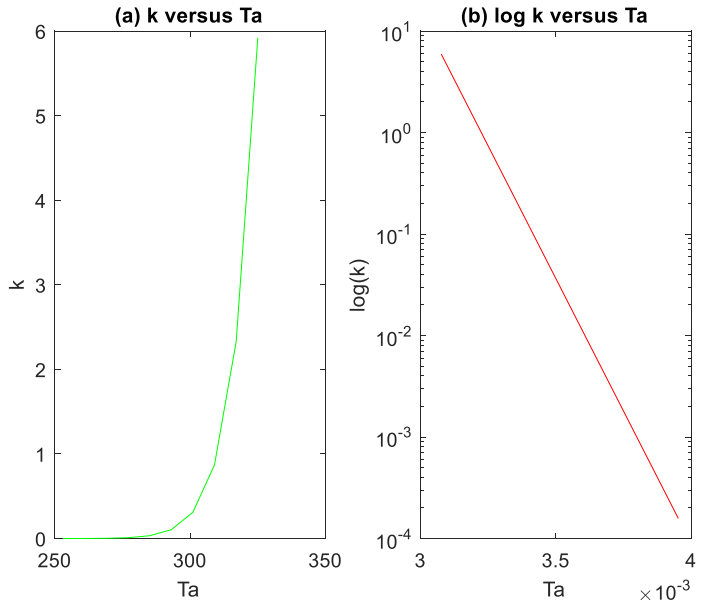
```
xlabel('Ta');ylabel('log(k)');title('(b) log k versus Ta')
```



The result in **(b)** is a straight line. The reason for this outcome can be understood by taking the common logarithm of the function to give,

$$\log_{10} k = \log_{10} A - \left(\frac{E}{R}\log_{10} e\right)\frac{1}{T_a}$$

Thus, a plot of $\log_{10}k$ versus $1/T_a$ is linear with a slope of $-(E/R)\log_{10}e$ and an intercept of $\log_{10}A$.

2.26 The equations to generate the plots are

$$(a)\ y = \frac{w_0}{120EIL}(-x^5 + 2L^2x^3 - L^4x)$$

$$(b)\ \frac{dy}{dx} = \frac{w_0}{120EIL}(-5x^4 + 6L^2x^2 - L^4)$$

$$(c)\ M(x) = EI\frac{d^2y}{dx^2} = \frac{w_0}{120L}(-20x^3 + 12L^2x)$$

$$(d)\ V(x) = EI\frac{d^3y}{dx^3} = \frac{w_0}{120L}(-60x^2 + 12L^2)$$

$$(e)\ w(x) = -EI\frac{d^2y}{dx^2}$$

The following MATLAB script can be developed to generate the plot:

```
format short g
```

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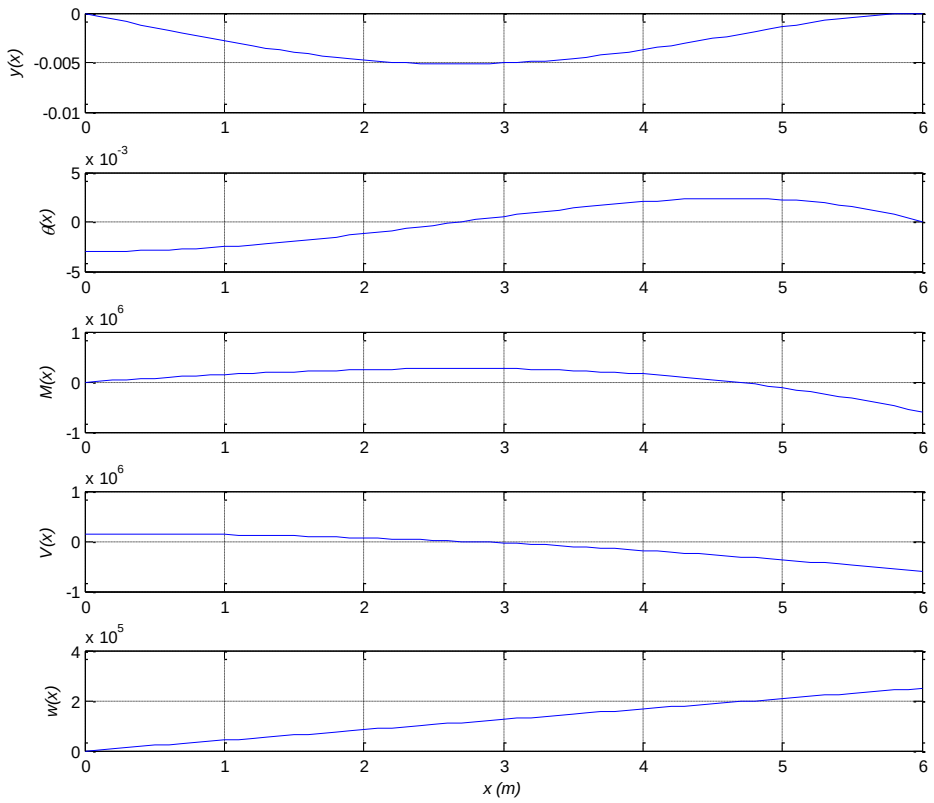
```
E=50000*1e3*1e4;I=0.0003;w0=2.5e3*100;L=600/100;dx=10/100;
x=[0:dx:L];
clf
y=w0/(120*E*I*L)*(-x.^5+2*L^2*x.^3-L^4.*x);
theta=w0/(120*E*I*L)*(-5*x.^4+6*L^2*x.^2-L^4);
M=w0/(120*L)*(-20*x.^3+12*L^2*x);
V=w0/(120*L)*(-60*x.^2+12*L^2);
w=w0/L*x;
subplot(5,1,1)
plot(x,y);grid;ylabel('\ity(x)')
subplot(5,1,2)
plot(x,theta);grid;ylabel('\it\theta(x)')
subplot(5,1,3)
plot(x,M);grid;ylabel('\itM(x)')
subplot(5,1,4)
plot(x,V);grid;ylabel('\itV(x)')
subplot(5,1,5)
plot(x,w);grid;ylabel('\itw(x)')
xlabel('\itx (m)')
```

The resulting plot is



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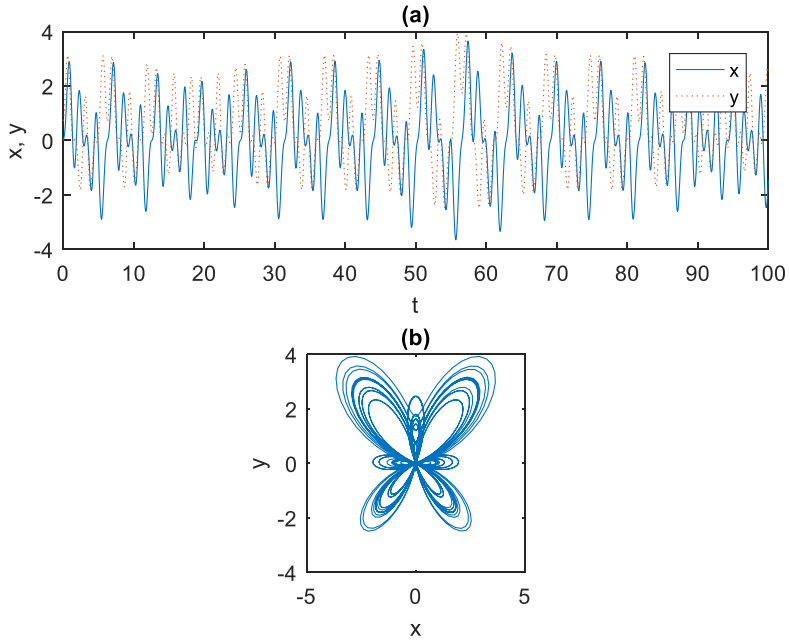
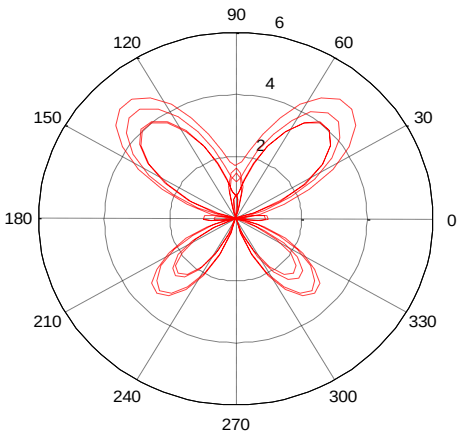
2.27

```
clear, clc, format compact
t=[0:1/16:100];
x=sin(t).*(exp(cos(t))-2*cos(4*t)-sin(t/12).^5);
y=cos(t).*(exp(cos(t))-2*cos(4*t)-sin(t/12).^5);
subplot(2,1,1)
plot(t,x,t,y,':');title('(a)');xlabel('t');ylabel('x,
y');legend('x','y')
subplot(2,1,2)
plot(x,y);axis square;title('(b)');xlabel('x');ylabel('y')
```



2.28

```
clf
t = 0:pi/32:8*pi;
polar(t,exp(sin(t))-2*cos(4*t)+sin((2*t-pi)/24).^5,'--r')
```



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