

## CHAPTER 2

### 2.1 (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
```

### 2.2 (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
```

**2.3** 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
```

### 2.4 (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
```

### 2.5

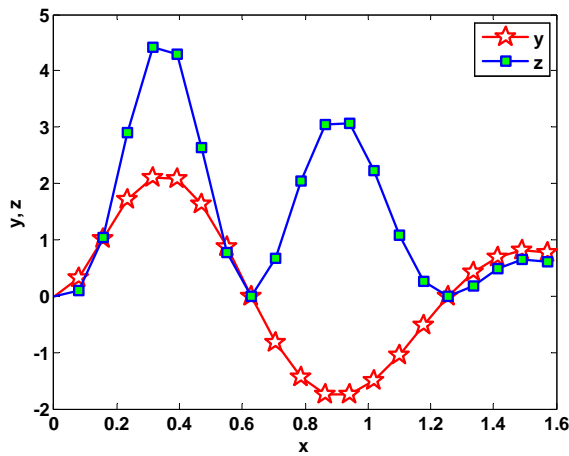
```
format short g
a=2;b=5;
x=0:pi/40:pi/2;
y=b*exp(-a*x).*sin(b*x).*(0.012*x.^4-0.15*x.^3+0.075*x.^2+2.5*x);
z=y.^2;
w = [x' y' z']
plot(x,y,'-pr','LineWidth',1.5,'MarkerSize',14,...
     'MarkerEdgeColor','r','MarkerFaceColor','w')
hold on
plot(x,z,'-sb','MarkerFaceColor','g')
xlabel('x'); ylabel('y,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

Output:

**PROPRIETARY MATERIAL.** © The McGraw-Hill Companies, Inc. All rights reserved. No part of this Manual may be displayed, reproduced or distributed in any form or by any means, without the prior written permission of the publisher, or used beyond the limited distribution to teachers and educators permitted by McGraw-Hill for their individual course preparation. If you are a student using this Manual, you are using it without permission.

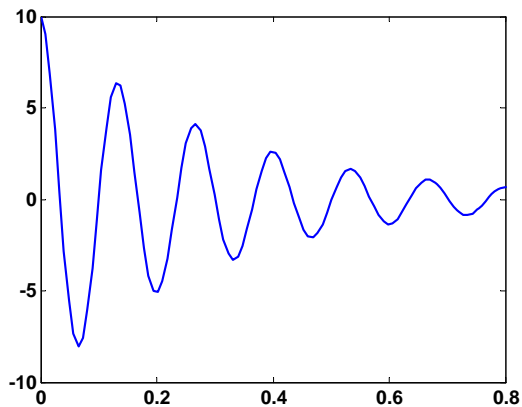
w =

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-016	7.4392e-032
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-016	8.811e-032
1.3352	0.41762	0.1744
1.4137	0.69202	0.4789
1.4923	0.80787	0.65265
1.5708	0.77866	0.60631



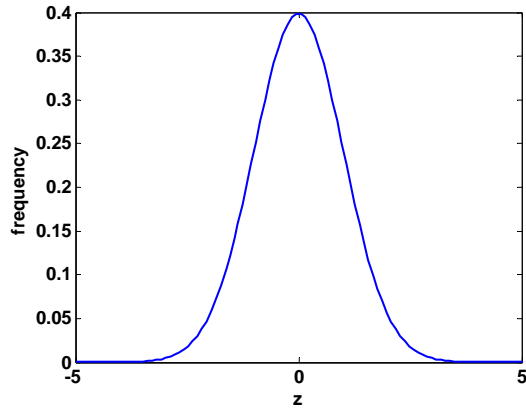
## 2.6

```
>> 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)
```



## 2.7

```
>> z = linspace(-4,4);
>> f = 1/sqrt(2*pi)*exp(-z.^2/2);
>> plot(z,f)
>> xlabel('z')
>> ylabel('frequency')
```

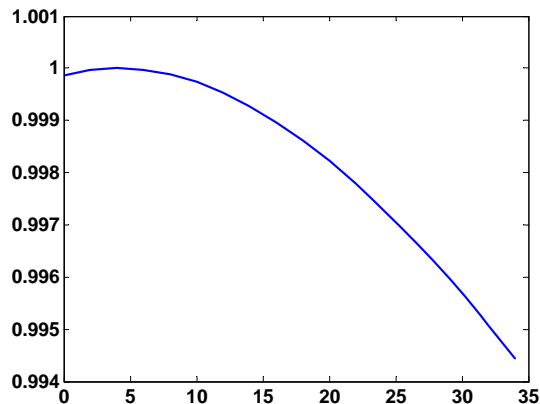


## 2.8

```
>> 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
```

## 2.9

```
>> TF = 32:3.6:82.4;
>> 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)
```

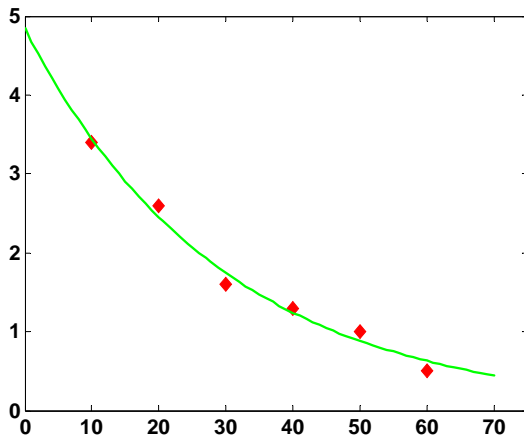


**2.10**

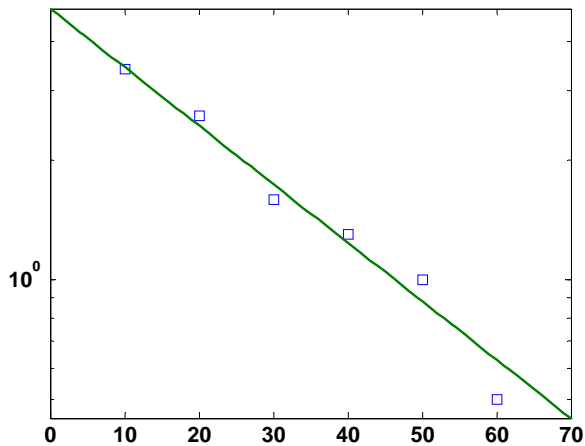
```
>> A = [.035 .0001 10 2;
0.02 0.0002 8 1;
0.015 0.001 20 1.5;
0.03 0.0007 24 3;
0.022 0.0003 15 2.5]
A =
    0.035    0.0001    10     2
    0.02     0.0002     8     1
    0.015    0.001    20    1.5
    0.03     0.0007    24     3
    0.022    0.0003    15    2.5
>> U = sqrt(A(:,2))./A(:,1).*(A(:,3).*A(:,4)./(A(:,3)+2*A(:,4))).^(2/3)
U =
    0.36241
    0.60937
    2.5167
    1.5809
    1.1971
```

**2.11**

```
>> 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
```

**2.12**

```
>> 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(t,c,'s','tf,cf,':')
```



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

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

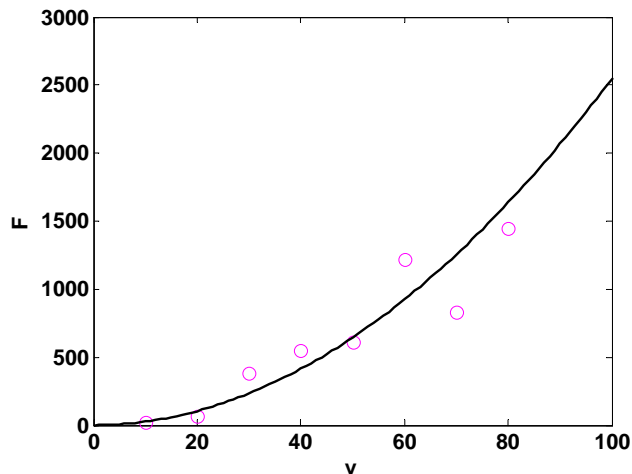
or because  $\ln e^{-0.034t} = -0.034t$ ,

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

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

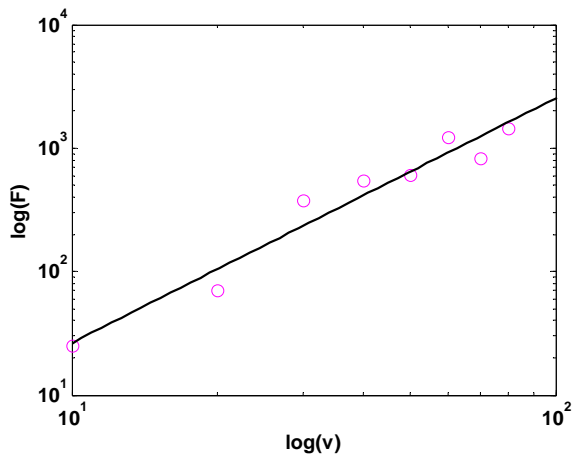
### 2.13

```
>> v = 10:10:80;
>> 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');
```



## 2.14

```
>> 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('log(v)');ylabel('log(F)');
```



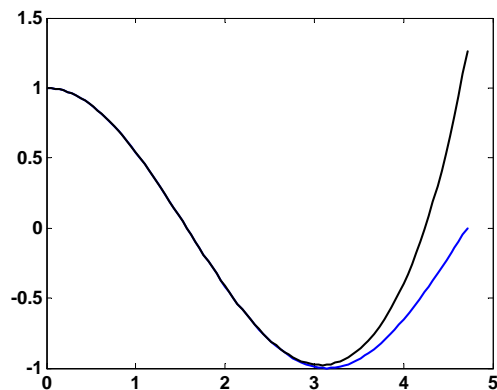
The result is a straight line. The reason for this outcome can be understood by taking the common logarithm of the function to give,

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

Thus, on a log-log plot, the slope would be 1.9842 and the intercept would be  $\log_{10}(0.2741) = -0.562$ .

## 2.15

```
>> 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,'k--')
```



## 2.16 (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
```

**PROPRIETARY MATERIAL.** © The McGraw-Hill Companies, Inc. All rights reserved. No part of this Manual may be displayed, reproduced or distributed in any form or by any means, without the prior written permission of the publisher, or used beyond the limited distribution to teachers and educators permitted by McGraw-Hill for their individual course preparation. If you are a student using this Manual, you are using it without permission.

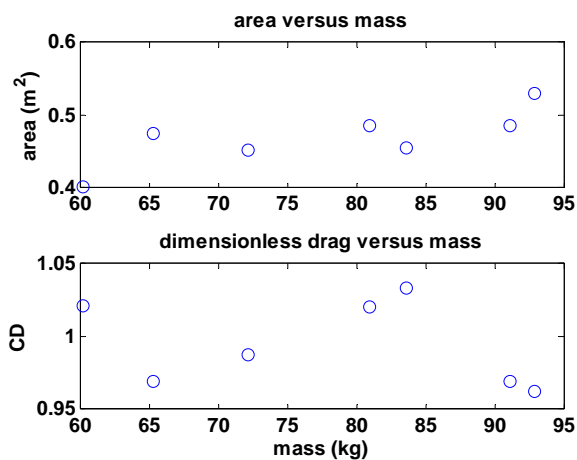
```
CD =
    1.0337    1.0213    0.9877    0.9693    0.9625    0.9693    1.0206
```

(b)

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

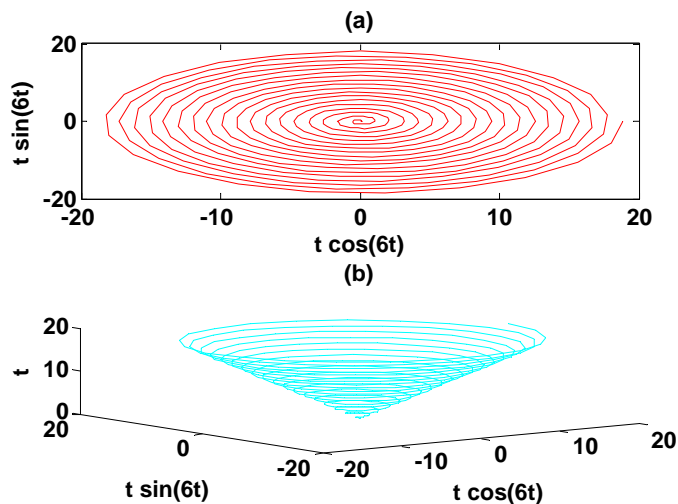
(c)

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



2.17 (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')
```



**2.18 (a)**

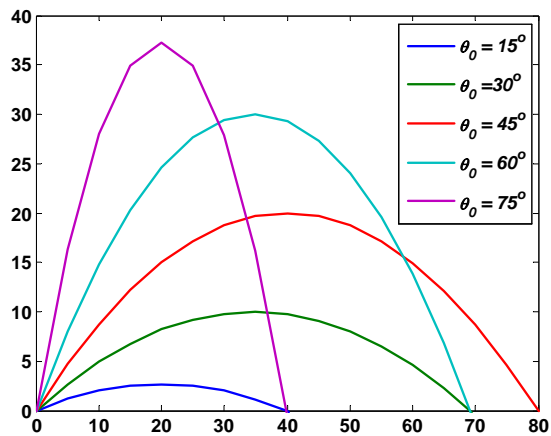
```
>> x = 5;
>> x ^ 3;
>> y = 8 - x
y =
     3
```

**(b)**

```
>> q = 4:2:12;
>> r = [7 8 4; 3 6 -5];
>> sum(q) * r(2,3)
q =
    -200
```

**2.19**

```
>> clf
>> 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')
```

**2.20**

```
>> clf
>> R=8.314;E=1e5;A=7E16;
>> Ta=253:8:325;
>> k=A*exp(-E./(R*Ta))
k =
    0.0002    0.00070    0.00270    0.0097    0.0328    0.1040    0.3096    0.8711    2.3265    5.9200
```

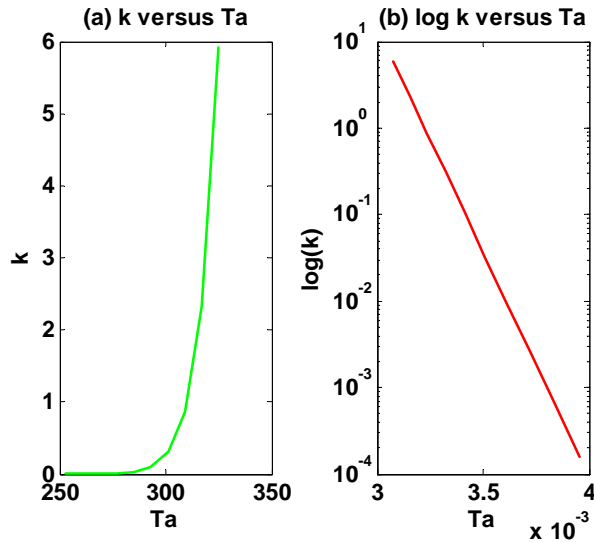
```
R=8.314;E=1e5;A=7E16;
Ta=253:8:325;
k=A*exp(-E./(R*Ta))
subplot(1,2,1);plot(Ta,k,'g')
```



```

xlabel('Ta');ylabel('k');title('(a) k versus Ta')
subplot(1,2,2);semilogy(1./Ta,k,'r')
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  $\log_{10} A$ .

**2.21** The equations to generate the plots are

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

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

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

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

$$(e) \quad w(x) = EI \frac{d^4y}{dx^4} = \frac{w_0}{L} x$$

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

```

format short g
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);

```

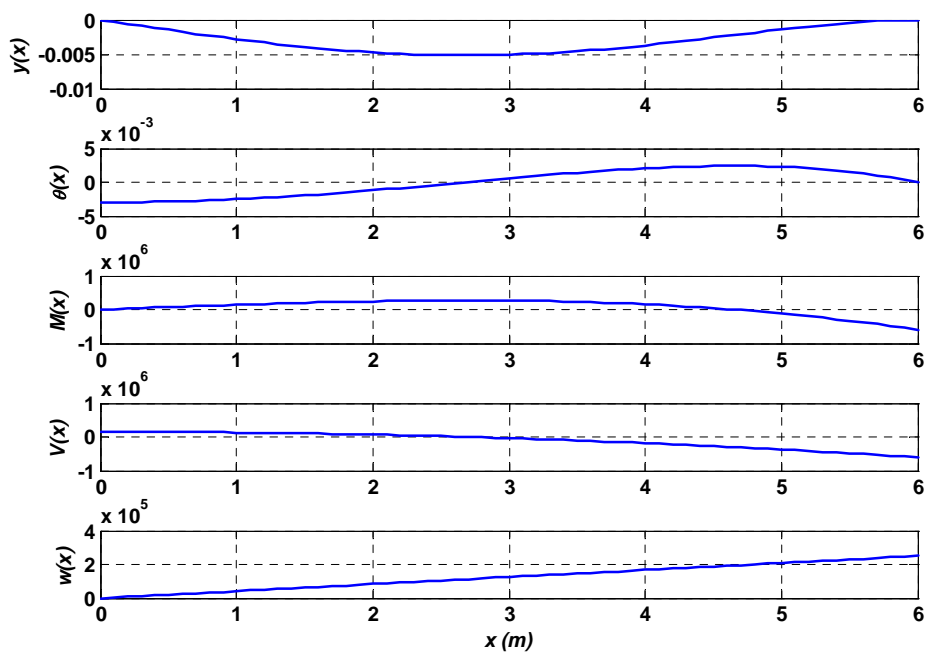
**PROPRIETARY MATERIAL.** © The McGraw-Hill Companies, Inc. All rights reserved. No part of this Manual may be displayed, reproduced or distributed in any form or by any means, without the prior written permission of the publisher, or used beyond the limited distribution to teachers and educators permitted by McGraw-Hill for their individual course preparation. If you are a student using this Manual, you are using it without permission.

```

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

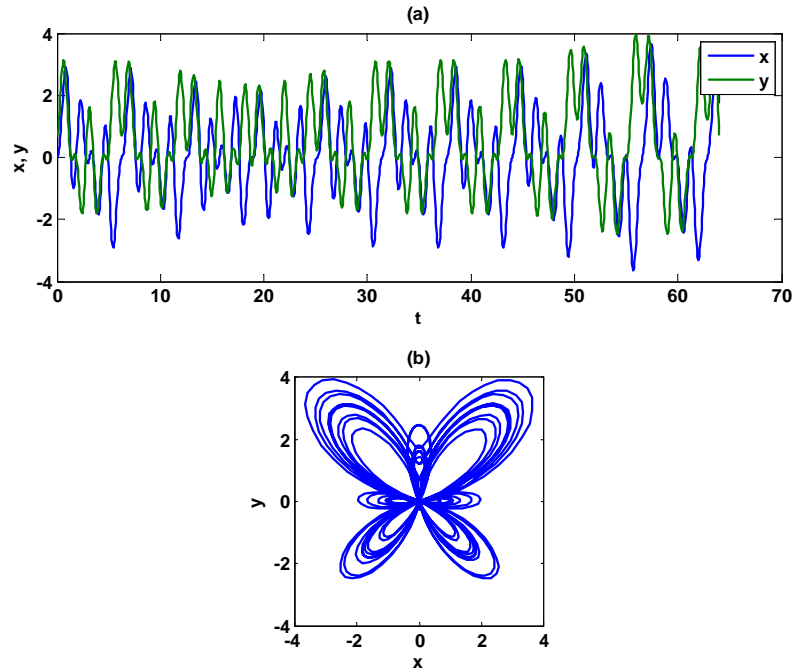


## 2.22

```

clf
t=[0:1/16:64];
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')

```



### 2.23

clf

t = 0:pi/32:8\*pi;

polar(t,exp(sin(t))-2\*cos(4\*t)+sin((2\*t-pi)/24).^5,'--r')

