

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

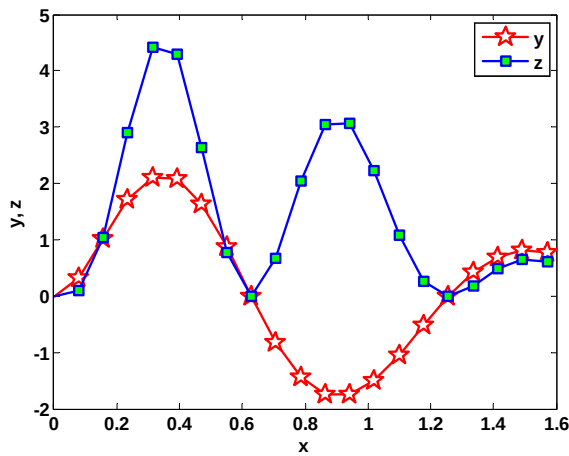
```
format short g
a=2;b=5;
x=0:pi/40:pi/2;
y=b*exp(-a*x).*sin(b*x).*(0.012*x.^4-0.15*x.^3+0.075*x.^2+2.5*x);
z=y.^2;
w = [x' y' z']
plot(x,y,'-pr','LineWidth',1.5,'MarkerSize',14,...
     'MarkerEdgeColor','r','MarkerFaceColor','w')
hold on
plot(x,z,'-sb','MarkerFaceColor','g')
xlabel('x'); ylabel('y,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

Output:

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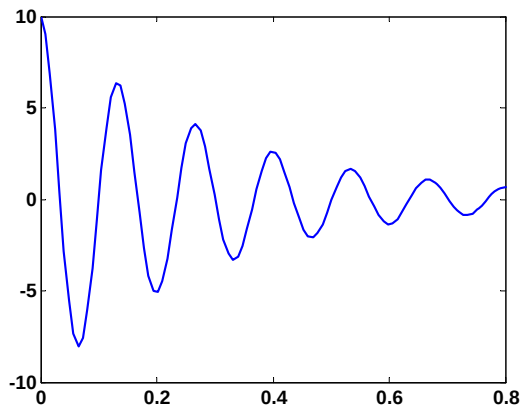
w =

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



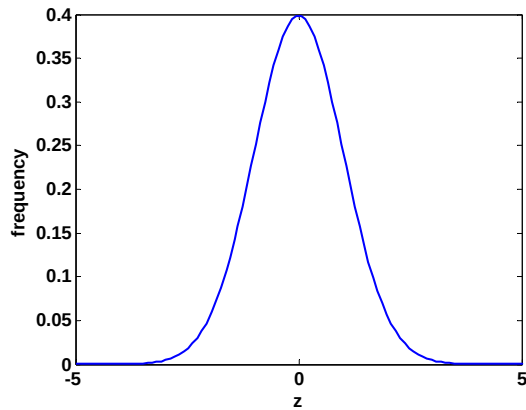
2.6

```
>> 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')
```

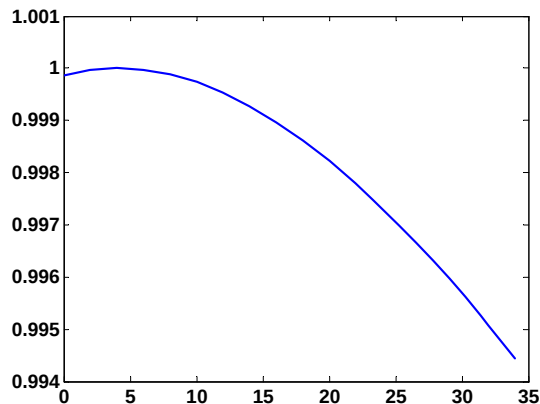


2.8

```
>> 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)
```

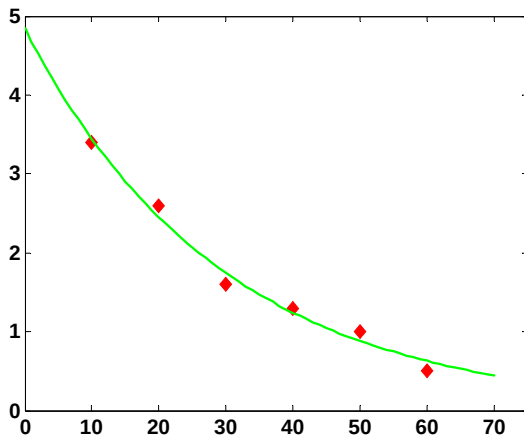


2.10

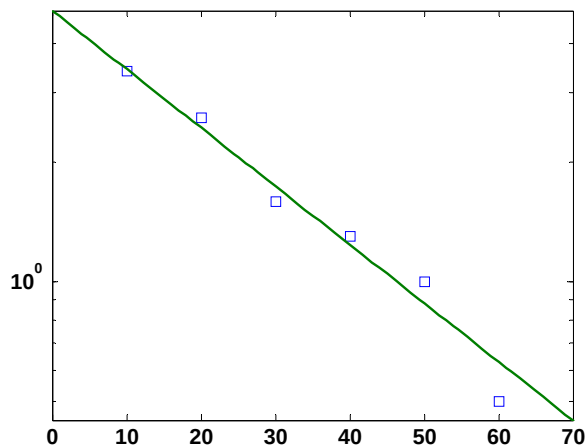
```
>> A = [.035 .0001 10 2;
0.02 0.0002 8 1;
0.015 0.001 20 1.5;
0.03 0.0007 24 3;
0.022 0.0003 15 2.5]
A =
    0.035    0.0001    10     2
    0.02    0.0002     8     1
    0.015    0.001    20    1.5
    0.03    0.0007    24     3
    0.022    0.0003    15    2.5
>> U = sqrt(A(:,2))./A(:,1).*(A(:,3).*A(:,4)./(A(:,3)+2*A(:,4))).^(2/3)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

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

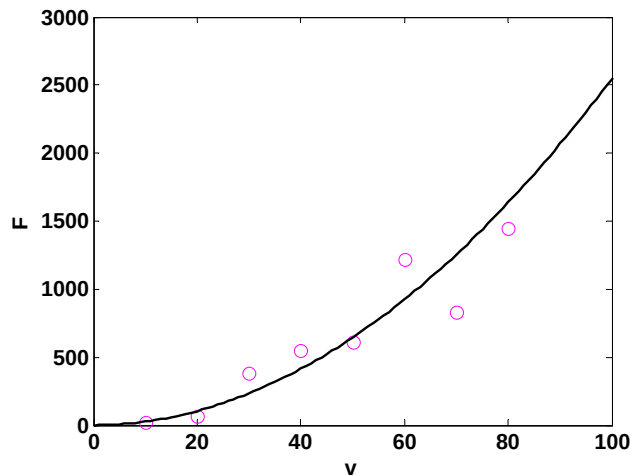
or because $\ln e^{-0.034t} = -0.034t$,

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

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 .

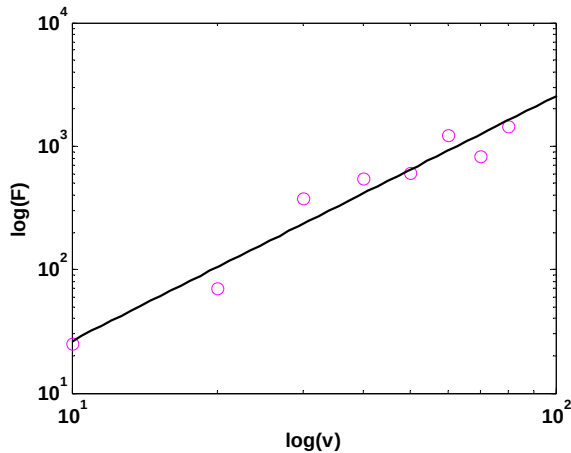
2.13

```
>> 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)');
```



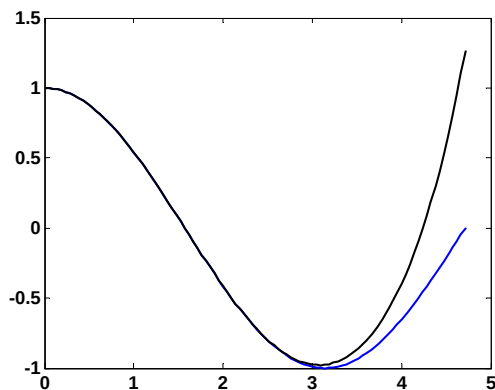
The result is a straight line. The reason for this outcome can be understood by taking the common logarithm of the function to give,

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

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--')
```



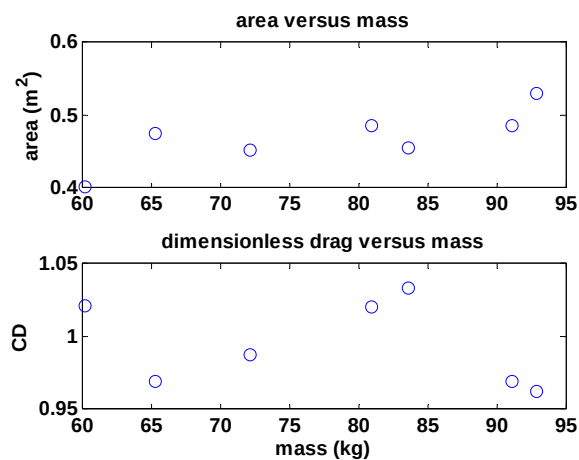
2.16 (a)

```
>> 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
```

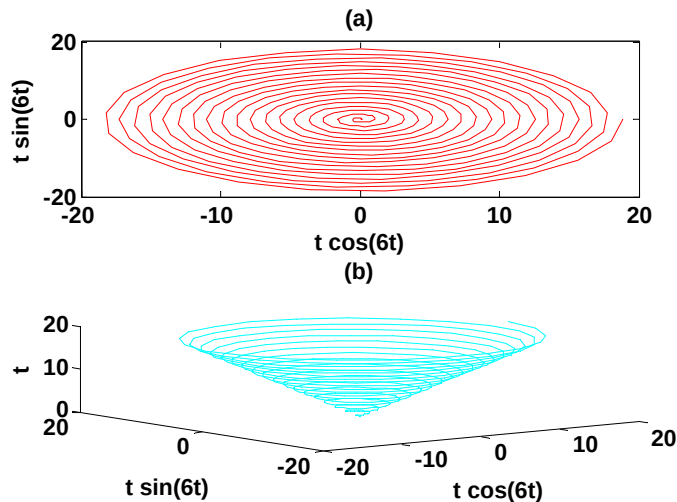
```
CD =
    1.0337    1.0213    0.9877    0.9693    0.9625    0.9693    1.0206
```

```
(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)

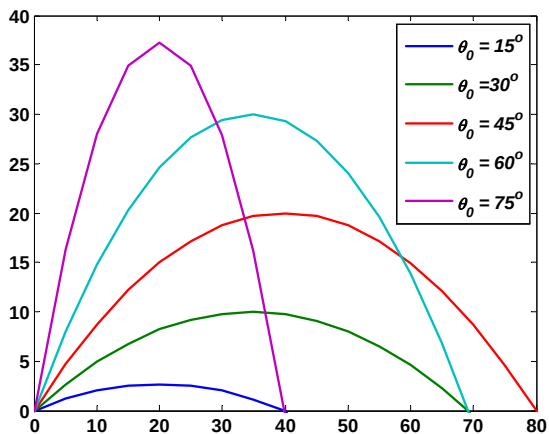
```
>> x = 5;
>> x ^ 3;
>> y = 8 - x
y =
    3
```

(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
```

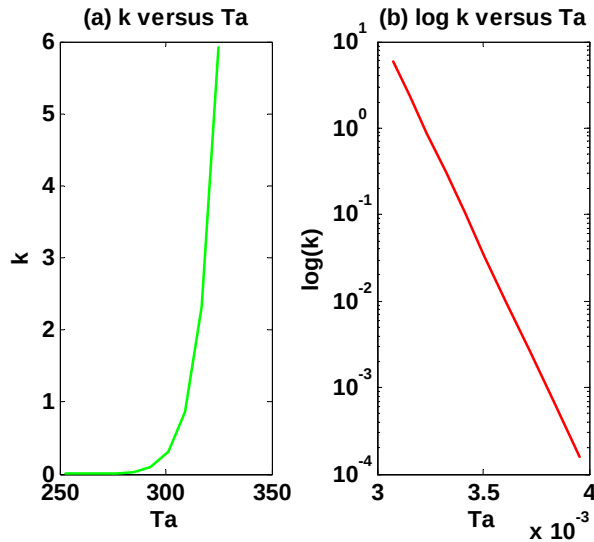
```
R=8.314;E=1e5;A=7E16;
Ta=253:8:325;
k=A*exp(-E./(R*Ta))
subplot(1,2,1);plot(Ta,k,'g')
```



```

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

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

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

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

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

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

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);

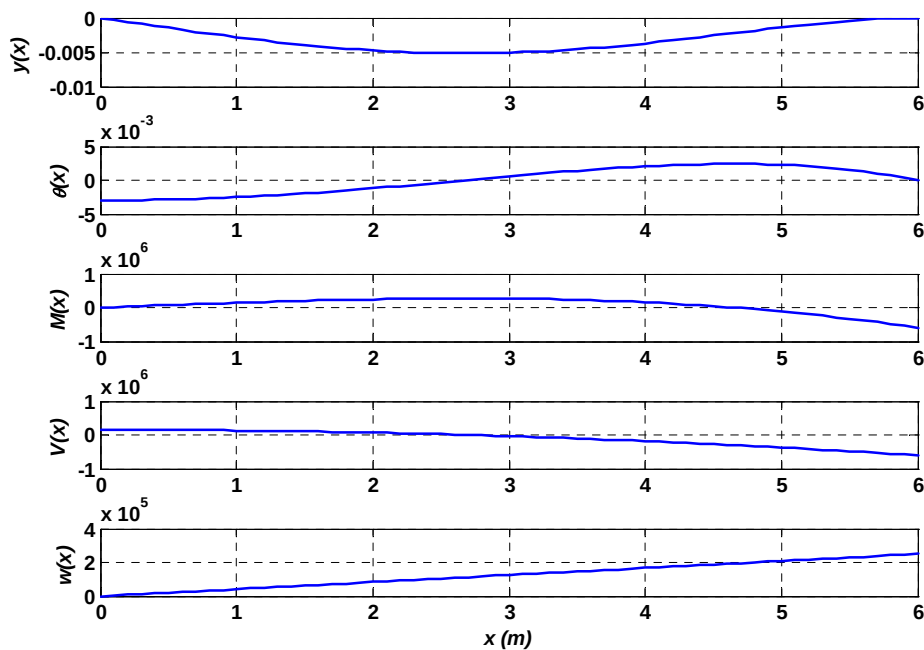
```

```

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

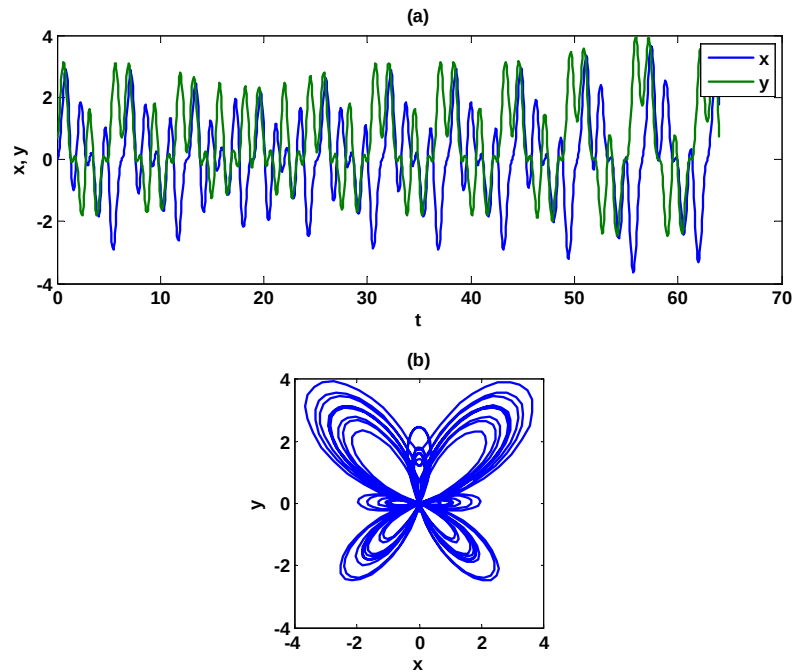


2.22

```

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')

```

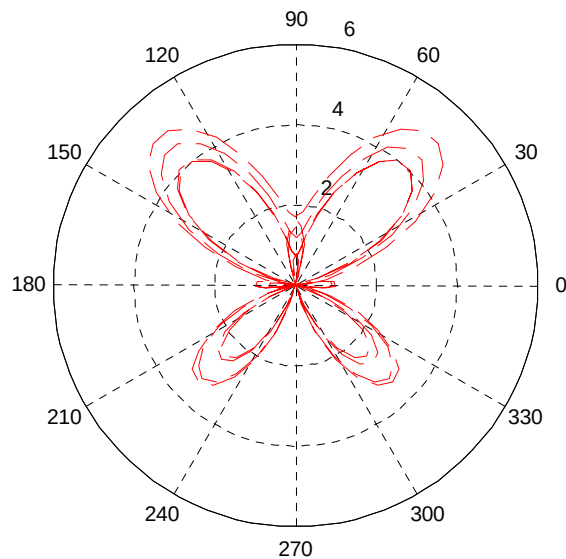


2.23

clf

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

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



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