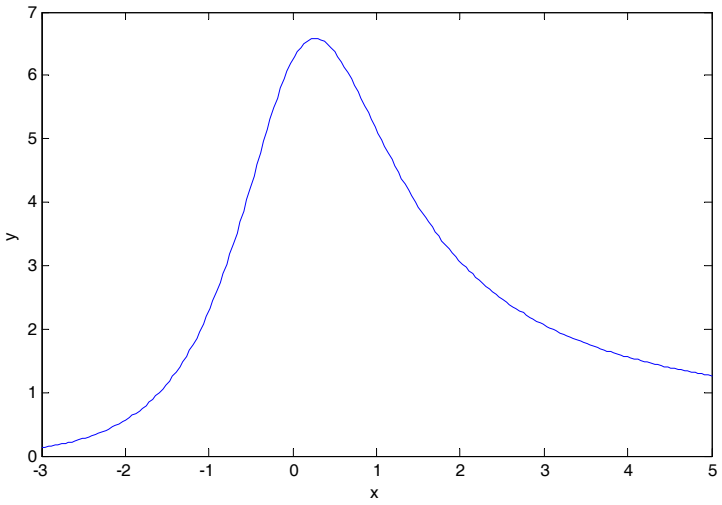
Chapter 5
Solved Problems

Problem 1

Script File:

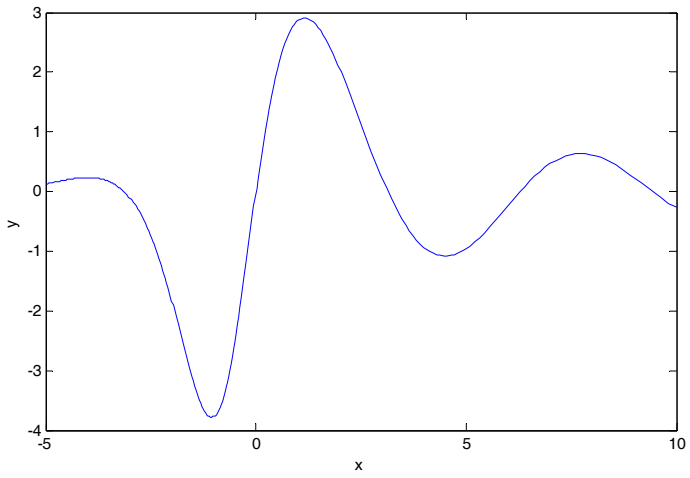
```
x=linspace(-3,5,200);
y=(x+5).^2./(4+3*x.^2);
plot(x,y)
xlabel('x')
ylabel('y')
```



Problem 2

Script File:

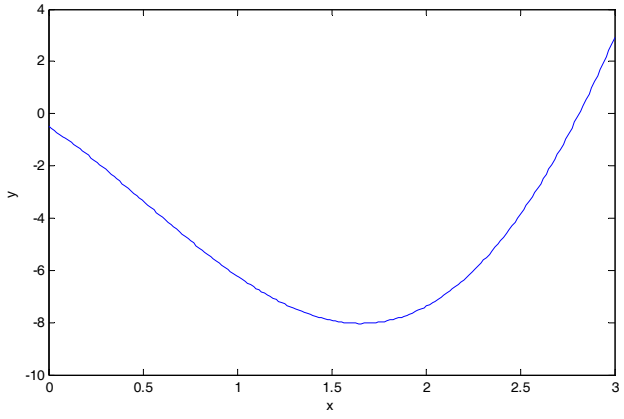
```
fplot('5*sin(x)/(x+exp(-0.75*x))',[-5 10])
xlabel('x')
ylabel('y')
```

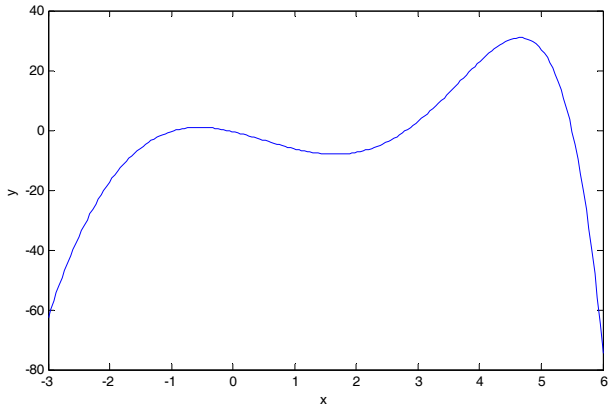


Problem 3

Script file:

```
x1=linspace(0,3,200);
y1=(x1+1).*(x1-2).*(2*x1-0.25)-exp(x1);
x2=linspace(-3,6,200);
y2=(x2+1).*(x2-2).*(2*x2-0.25)-exp(x2);
plot(x1,y1)
xlabel('x')
ylabel('y')
figure
plot(x2,y2)
xlabel('x')
ylabel('y')
```

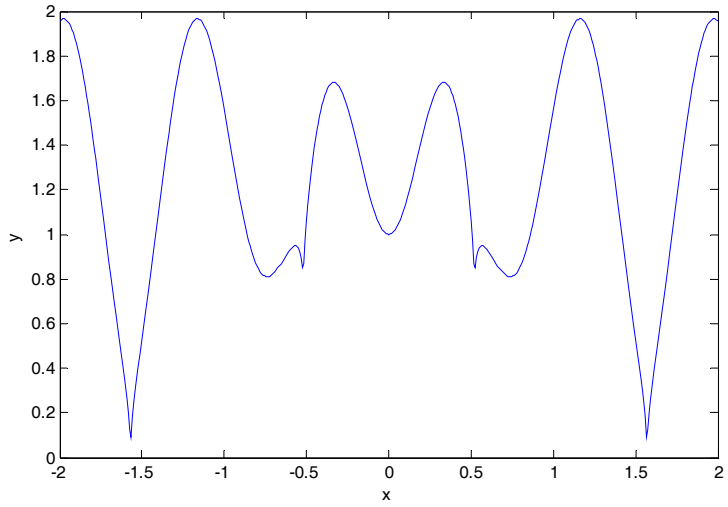




Problem 4

Script File:

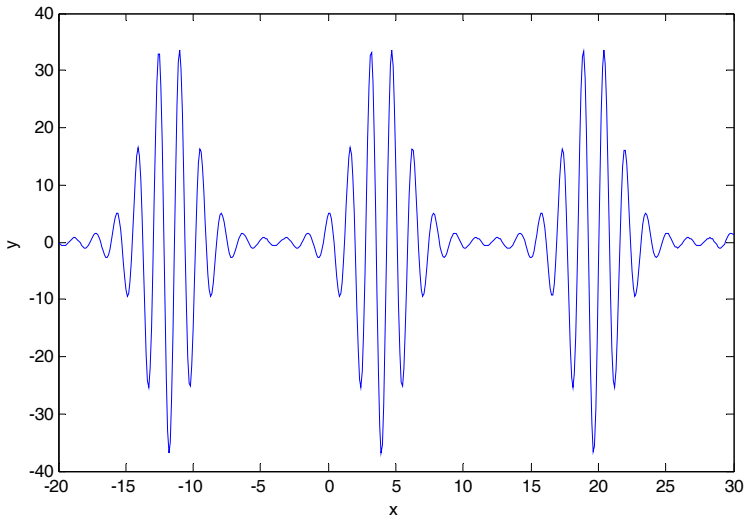
```
plot('sqrt(abs(cos(3*x)))+sin(4*x)^2',[-2 2])
xlabel('x')
ylabel('y'))
```



Problem 5

Script File:

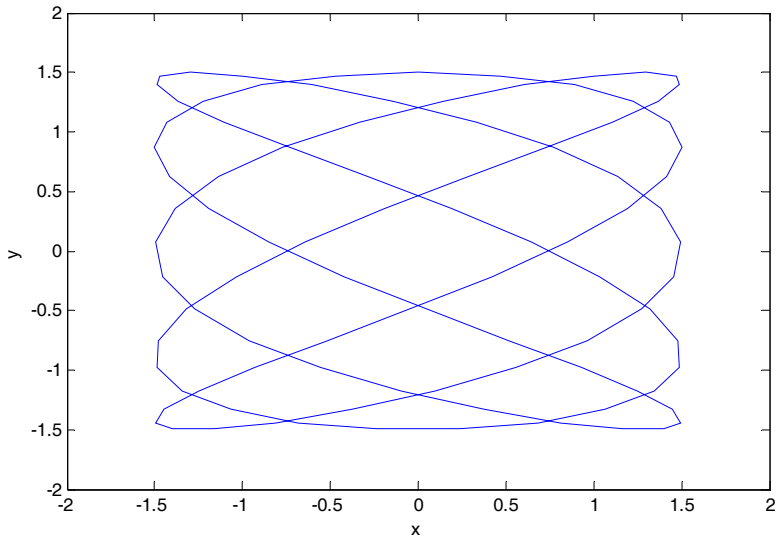
```
fplot('exp(2*sin(0.4*x))*5*cos(4*x)',[-20 30])
xlabel('x')
ylabel('y')
```



Problem 6

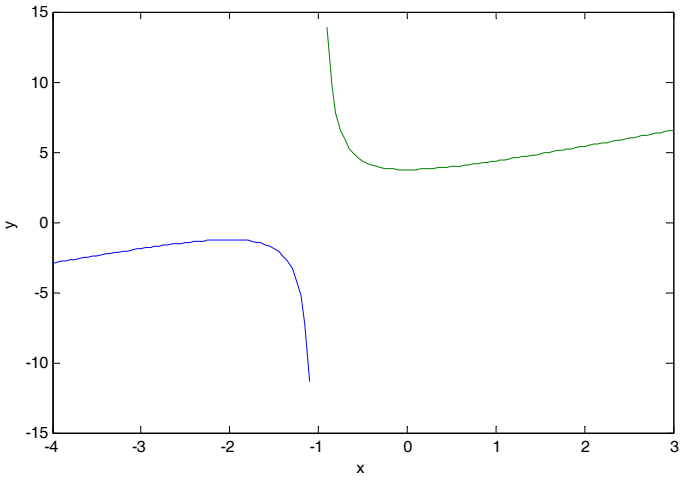
Script File:

```
t=linspace(0,2*pi,100);
x=1.5*sin(5*t);
y=1.5*cos(3*t);
plot(x,y)
axis([-2 2 -2 2])
xlabel('x')
ylabel('y')
```



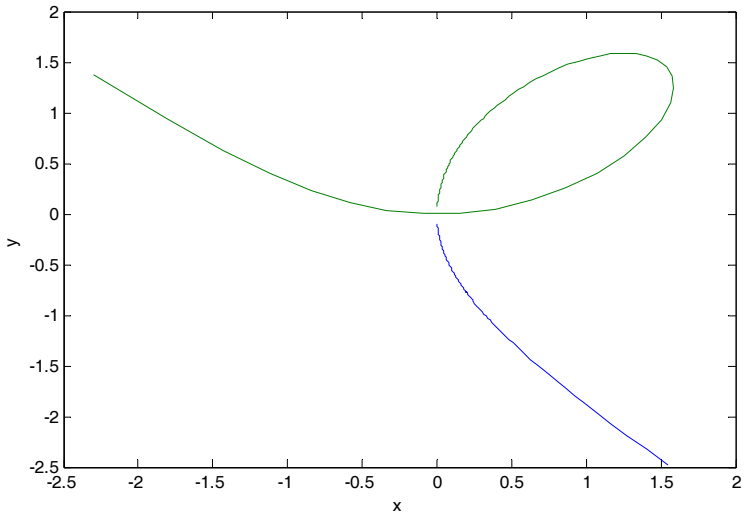
Problem 7

```
x1=-4:0.05:-1.1;
x2=-0.9:0.05:3;
y1=(x1.^2+3*x1+3)./(0.8*(x1+1));
y2=(x2.^2+3*x2+3)./(0.8*(x2+1));
plot(x1,y1,x2,y2)
xlabel('x')
ylabel('y')
```



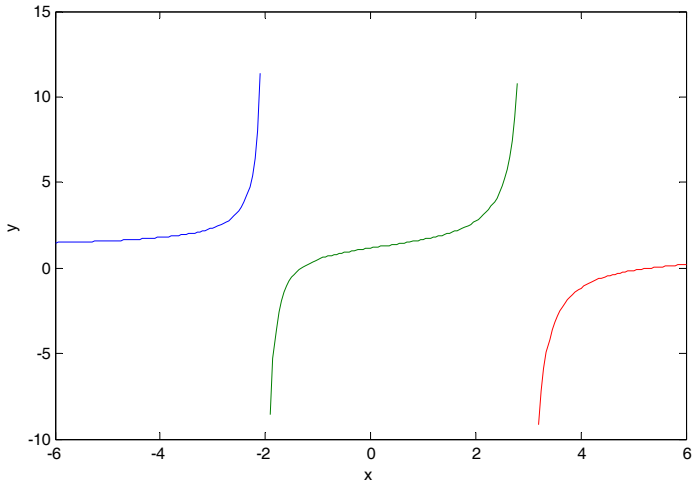
Problem 8

```
t1=linspace(-30,-1.6,500);
t2=linspace(-0.6,40,500);
x1=3*t1./(1+t1.^3);
y1=3*t1.^2./(1+t1.^3);
x2=3*t2./(1+t2.^3);
y2=3*t2.^2./(1+t2.^3);
plot(x1,y1,x2,y2)
xlabel('x')
ylabel('y')
```



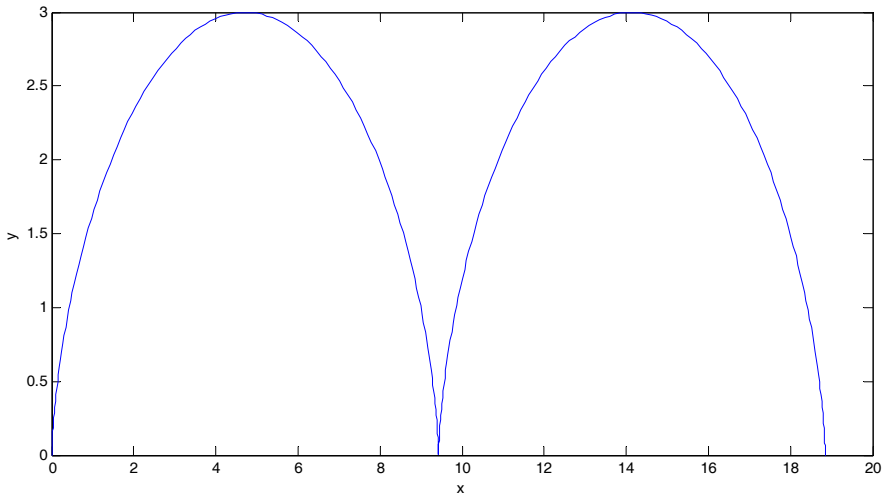
Problem 9

```
x1=-6:0.05:-2.1;
x2=-1.9:0.05:2.8;
x3=3.2:0.05:6;
y1=(x1.^2-4*x1-7)./(x1.^2-x1-6);
y2=(x2.^2-4*x2-7)./(x2.^2-x2-6);
y3=(x3.^2-4*x3-7)./(x3.^2-x3-6);
plot(x1,y1,x2,y2,x3,y3)
%axis([-10 10 -30 30])
xlabel('x')
ylabel('y')
```



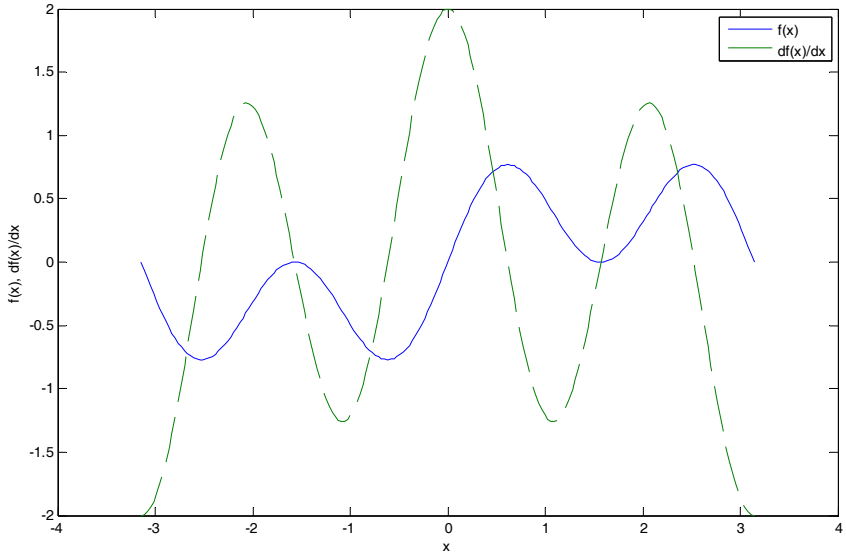
Problem 10

```
r=1.5;
t=linspace(0,4*pi,300);
x=r*(t-sin(t));
y=r*(1-cos(t));
plot(x,y)
xlabel('x')
ylabel('y')
```



Problem 11

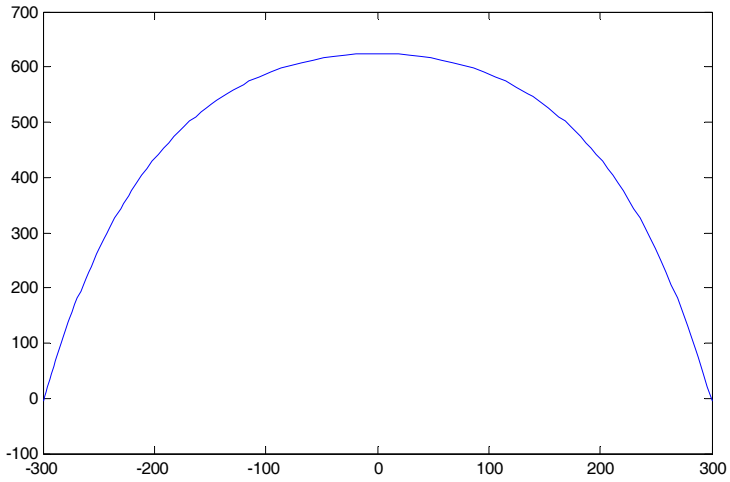
```
x=linspace(-pi,pi,200);
f=cos(x).*sin(2*x);
df=2*cos(2*x).*cos(x)-sin(2*x).*sin(x);
plot(x,f,x,df,'--')
xlabel('x')
ylabel('f(x), df(x)/dx')
legend('f(x)','df(x)/dx')
```



Problem 12

Command Window:

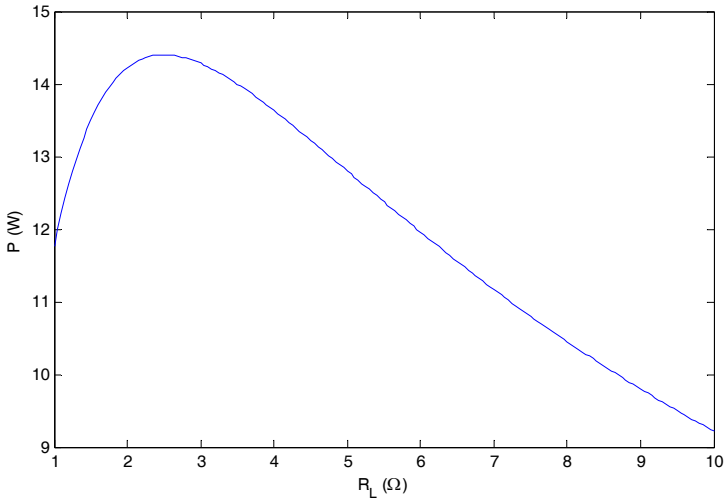
```
>> fplot('693.8-68.8*cosh(x/99.7)',[-300 300])
```



Problem 13

Script File:

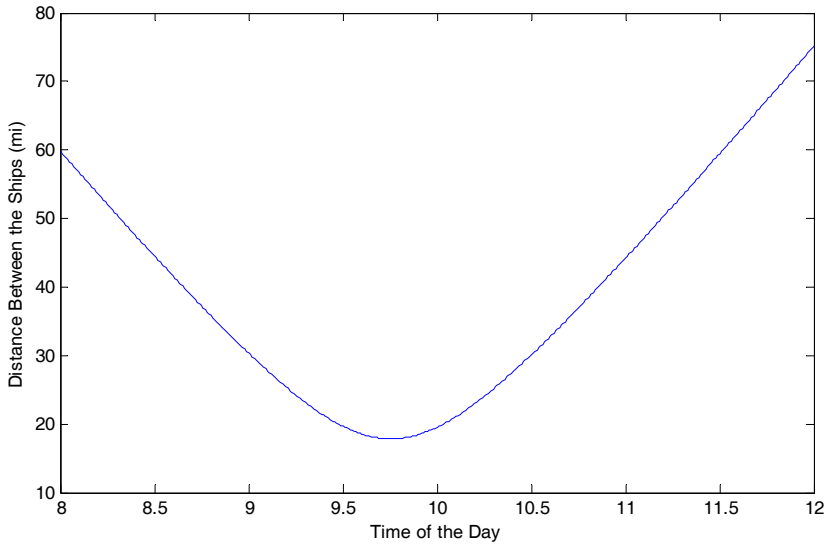
```
vs=12; rs=2.5;
RL=1:0.05:10;
P=vs^2*RL./(RL+rs).^2;
plot(RL,P)
xlabel('R_L (\Omega)')
ylabel('P (W)')
```



Problem 14

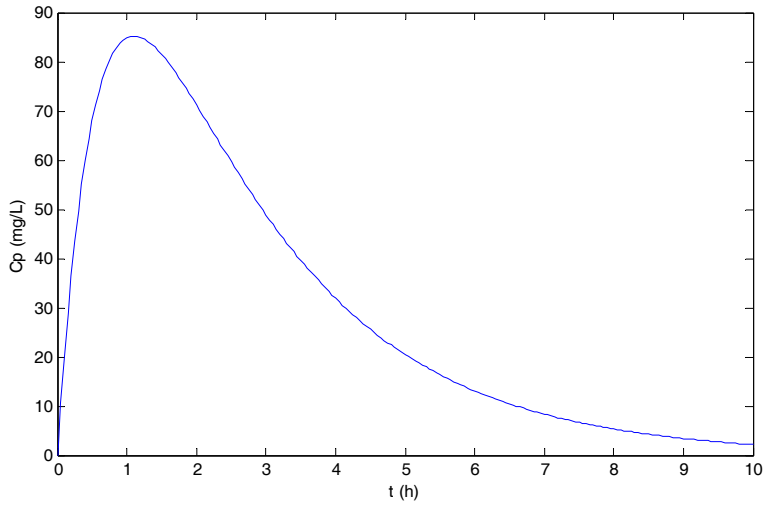
Script File:

```
t=0:0.01:4;
tDay=8+t;
vA=27; vB=14;
xA=-36+vA*cosd(30)*t;
yA=12-vA*sind(30)*t;
xB=-18+vB*cosd(70)*t;
yB=-45+vB*sind(70)*t;
dis=sqrt((xB-xA).^2+(yB-yA).^2);
plot(tDay,dis)
xlabel('Time of the Day')
ylabel('Distance Between the Ships (mi)')
```



Problem 15

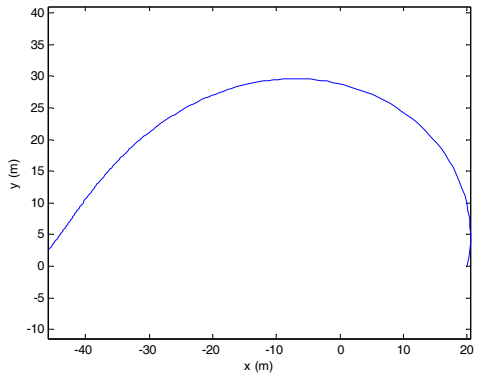
```
Kab=1.6; Kel=0.45;
C=140;
t=0:0.05:10;
Cp=C*Kab/(Kab-Kel)*(exp(-Kel*t)-exp(-Kab*t));
plot(t,Cp)
xlabel('t (h)')
ylabel('Cp (mg/L)')
```

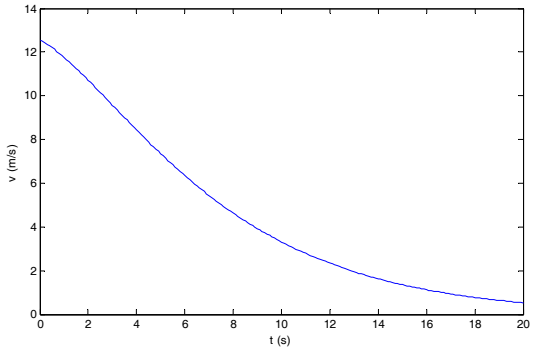


Problem 16

Script File:

```
t=0:0.1:20;
r= 20+ 30*(1-exp(-0.1*t));
th=pi*(1-exp(-0.2*t));
x=r.*cos(th);
y=r.*sin(th);
thdot=pi*0.2*exp(-0.2*t);
v=r.*thdot;
plot(x,y)
axis equal
xlabel('x (m)')
ylabel('y (m)')
figure
plot(t,v)
xlabel('t (s)')
ylabel('v (m/s)')
```

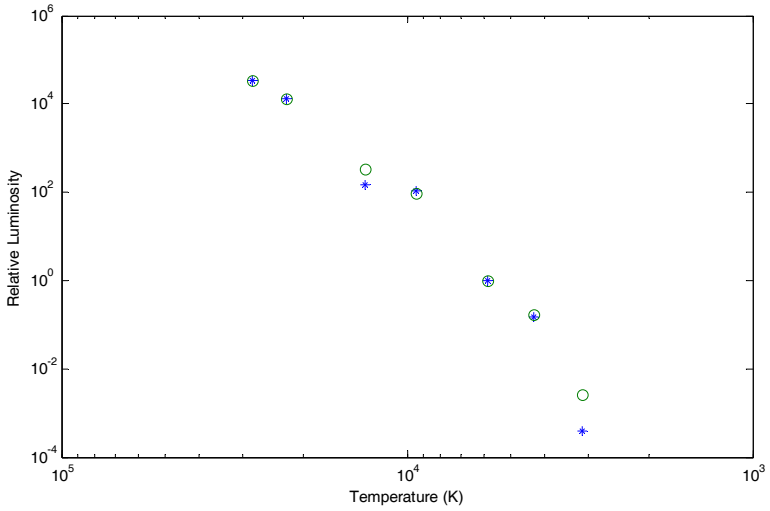




Problem 17

Script File:

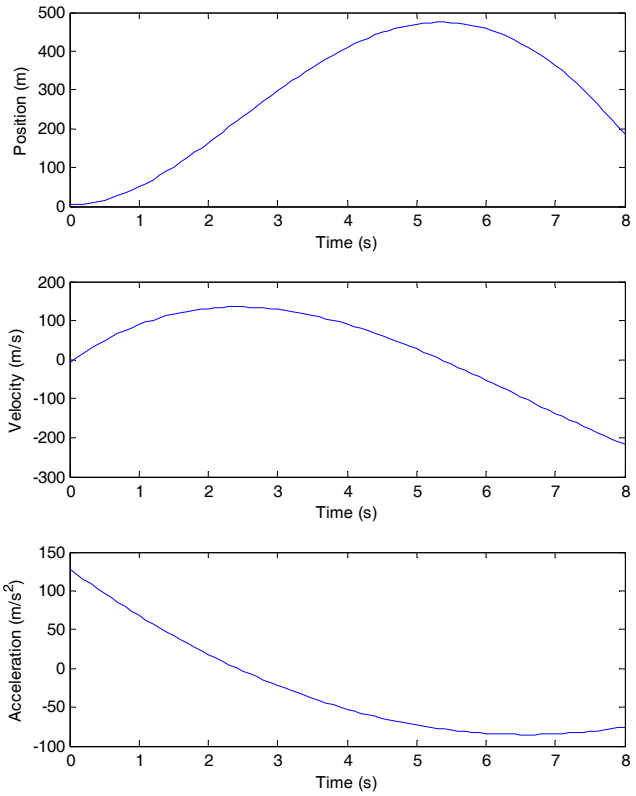
```
T=[5840 22400 13260 9400 3100 4300 28000];
L=[1 13400 150 108 0.0004 0.15 34000];
RR=[1 7.8 3.5 3.7 0.18 0.76 8];
LL=RR.^2.*(T/5840).^4;
han=loglog(T,L,'*',T,LL,'o');
set(gca,'XDir','reverse')
xlabel('Temperature (K)')
ylabel('Relative Luminosity')
```



Problem 18

Script File:

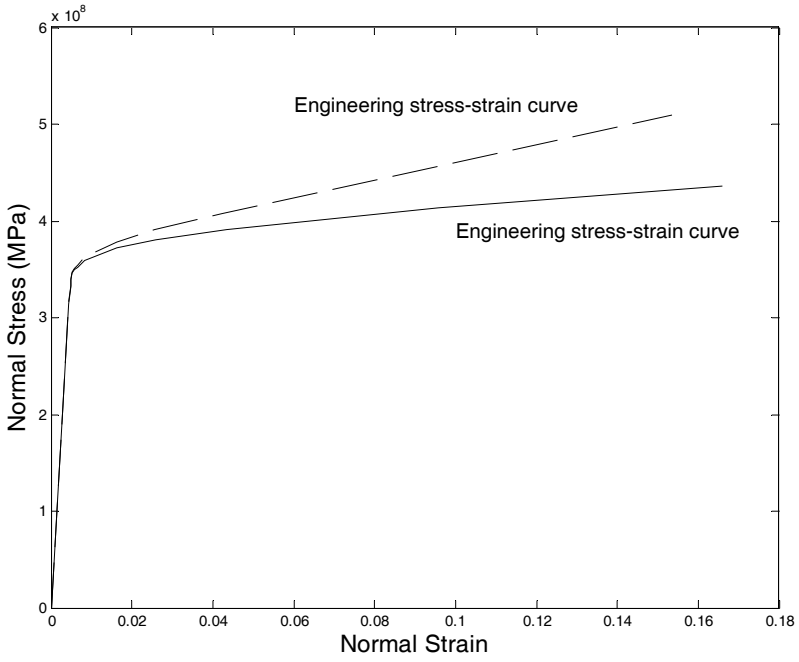
```
t=0:0.1:8;
x=0.41*t.^4-10.8*t.^3+64*t.^2-8.2*t+4.4;
v=0.41*4*t.^3-10.8*3*t.^2+64*2*t-8.2;
a=0.41*4*3*t.^2-10.8*3*2*t+64*2;
subplot(3,1,1)
plot(t,x)
xlabel('Time (s)')
ylabel('Position (m)')
subplot(3,1,2)
plot(t,v)
xlabel('Time (s)')
ylabel('Velocity (m/s)')
subplot(3,1,3)
plot(t,a)
xlabel('Time (s)')
ylabel('Acceleration (m/s^2)')
```


Position (m)
500
400
300
200
100
0
0 1 2 3 4 5 6 7 8
Time (s)
Velocity (m/s)
200
100
0
-100
-200
-300
0 1 2 3 4 5 6 7 8
Time (s)
Acceleration (m/s^2)
150
100
50
0
-50
-100
0 1 2 3 4 5 6 7 8
Time (s)

Problem 19

Script File:

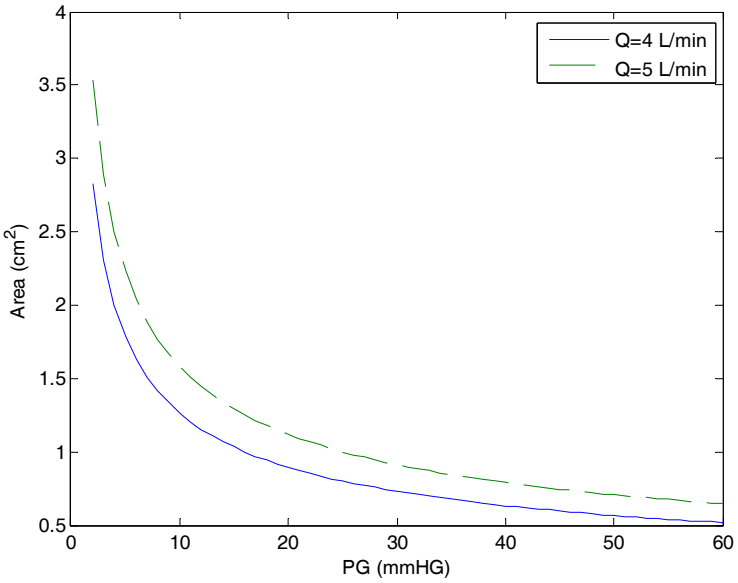
```
F=[0 13345 26689 40479 42703 43592 44482 44927 45372 46276
47908 49035 50265 53213 56161];
L=[25 25.037  25.073 25.113 25.122 25.125 25.132 25.144
25.164 25.208 25.409 25.646 26.084 27.398 29.150];
r=0.0064; L0=25;
A0=pi*r^2;
sigmaE=F./A0;
epsE=(L-L0)./L0;
sigmaT=sigmaE.*L./L0;
epsT=log(L./L0);
plot(epsE,sigmaE,'-k',epsT,sigmaT,'--k')
xlabel('Normal Strain','fontsize',16)
ylabel('Normal Stress (MPa)','fontsize',16)
text(0.1,390e6,'Engineering stress-strain curve','fon-
tsize',14)
text(0.06,520e6,'Engineering stress-strain curve','fon-
tsize',14)
```



Problem 20

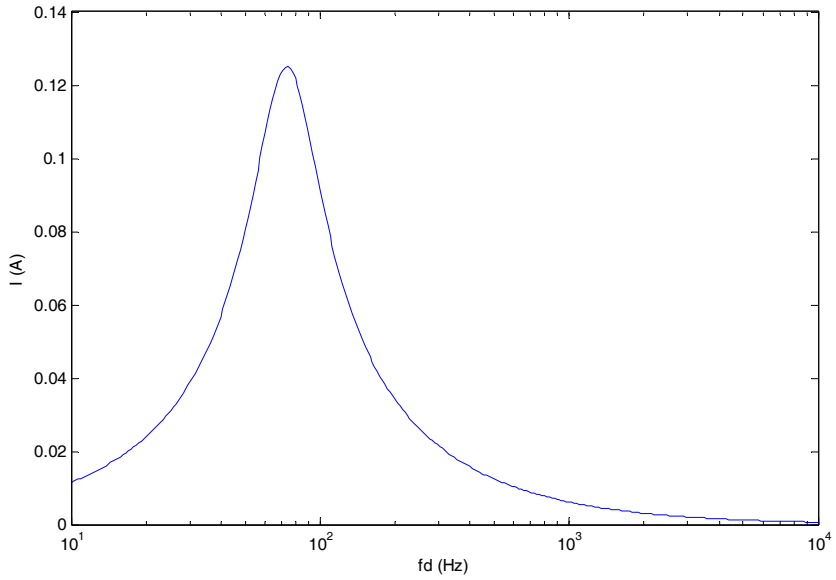
Script File:

```
Q1=4; Q2=5;
PG=2:1:60;
AV1=Q1./sqrt(PG);
AV2=Q2./sqrt(PG);
plot(PG,AV1,'-',PG,AV2,'--')
xlabel('PG (mmHG)')
ylabel('Area (cm^2)')
legend('Q=4 L/min','Q=5 L/min')
```



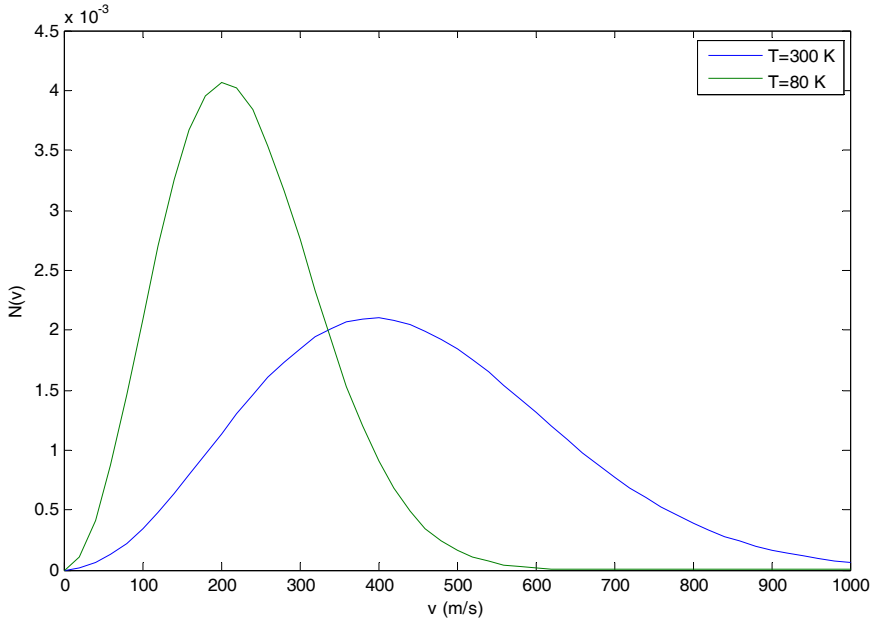
Problem 21

```
R=80; C=18E-6; L=260E-3;Vm=10;
k=1:0.01:4;
f=10.^k;
w=2*pi*f;
Is=Vm./sqrt(R^2+(w*L-1./(w*C)).^2);
semilogx(f,Is)
xlabel('fd (Hz)')
ylabel('I (A)')
```



Problem 22

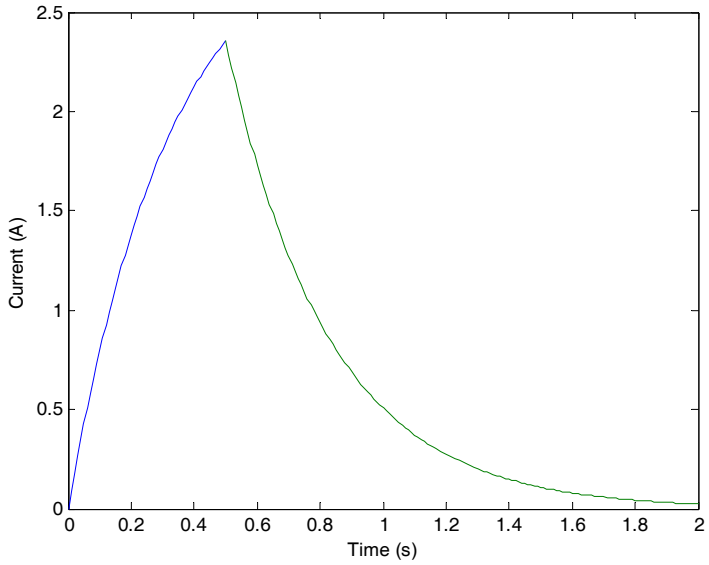
```
m=5.3E-26; kB=1.38E-23;
T1=300; T2=80;
v=0:20:1000;
K=m/(2*pi*kB);
Kex=m/(2*kB);
vsq=v.^2;
Nv1=4*pi*(K/T1)^(3/2)*vsq.*exp(-Kex/T1*vsq);
Nv2=4*pi*(K/T2)^(3/2)*vsq.*exp(-Kex/T2*vsq);
plot(v,Nv1,v,Nv2)
xlabel('v (m/s)')
ylabel('N(v)')
legend('T=300 K','T=80 K')
```



Problem 23

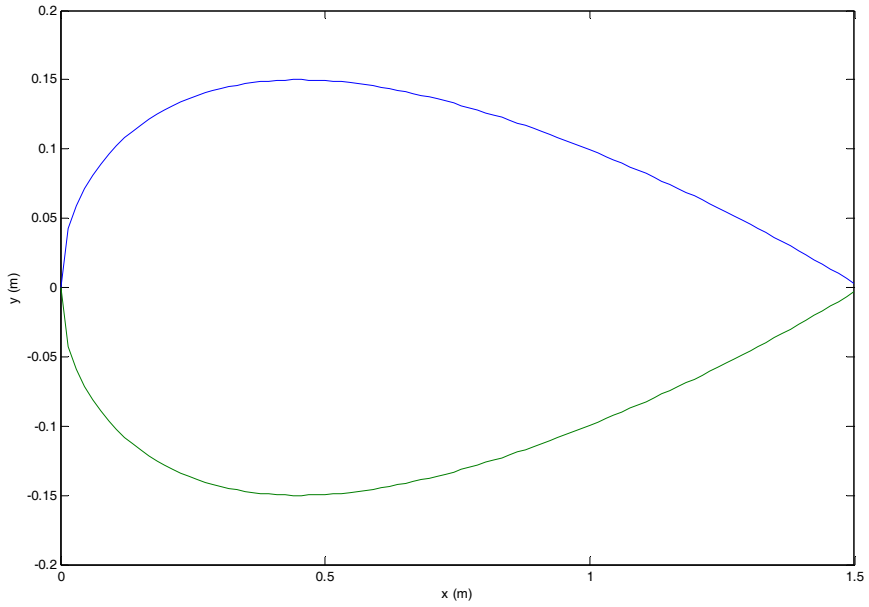
Script File:

```
R=4; L=1.3; V=12;
t1=0:0.01:0.5;
t2=0.5:0.01:2;
i1=V*(1-exp(-R*t1./L))/R;
i2=exp(-R*t2./L)*V.*(exp(0.5*R/L)-1)/R;
plot(t1,i1,t2,i2)
xlabel('Time (s)')
ylabel('Current (A)')
```



Problem 24

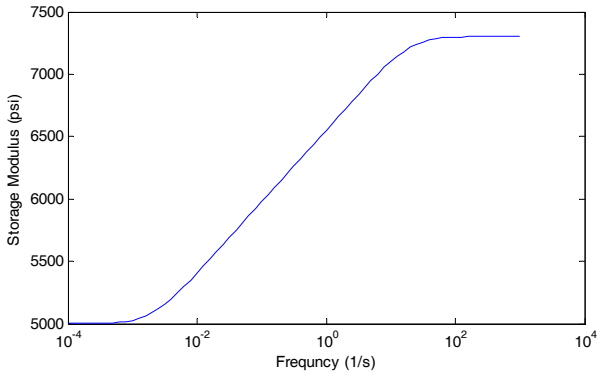
```
t=0.2;  c=1.5;
x=linspace(0,c,100);
xf=x/c;
yt=t*c/0.2*(0.2968*sqrt(xf)-0.126*xf-
0.3516*xf.^2+0.2843*xf.^3-0.1015*xf.^4);
yb=-t*c/0.2*(0.2968*sqrt(xf)-0.126*xf-
0.3516*xf.^2+0.2843*xf.^3-0.1015*xf.^4);
plot(x,yt,x,yb)
axis([0 1.5 -0.2 0.2])
xlabel('x (m)')
ylabel('y (m)')
```

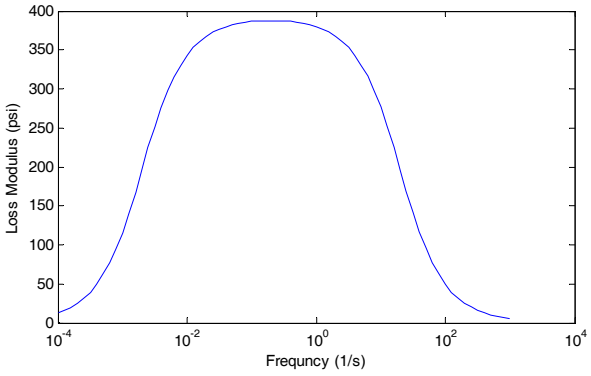


Problem 25

Script File:

```
Ginf=5000; c=0.05; tau1=0.05; tau2=500;
L=-4:0.1:3;
w=10.^L;
Gp=Ginf*(1+c*log((1+(w*tau2).^2)./(1+(w*tau1).^2))/2);
Gpp=c*Ginf*(atan(w*tau2)-atan(w*tau1));
subplot(2,1,1)
semilogx(w,Gp)
xlabel('Frequncy (1/s)')
ylabel('Storage Modulus (psi)')
subplot(2,1,2)
semilogx(w,Gpp)
xlabel('Frequncy (1/s)')
ylabel('Loss Modulus (psi)')
```

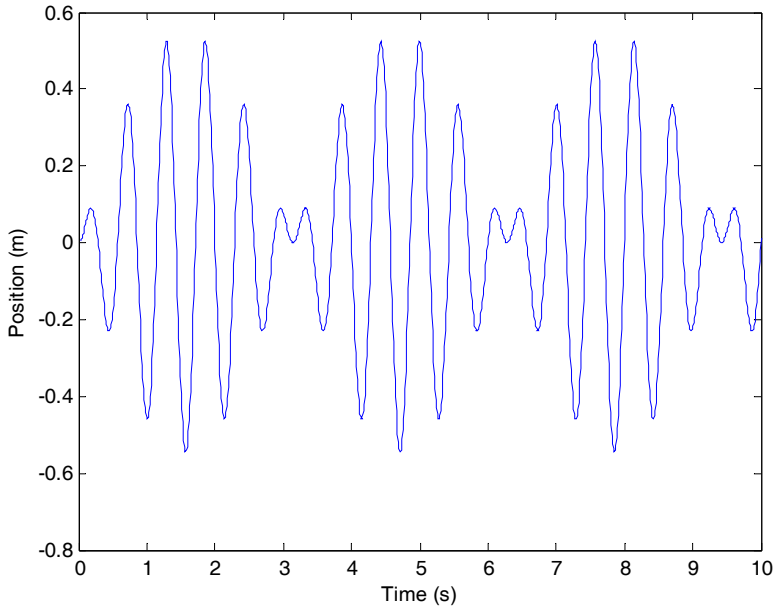




Problem 26

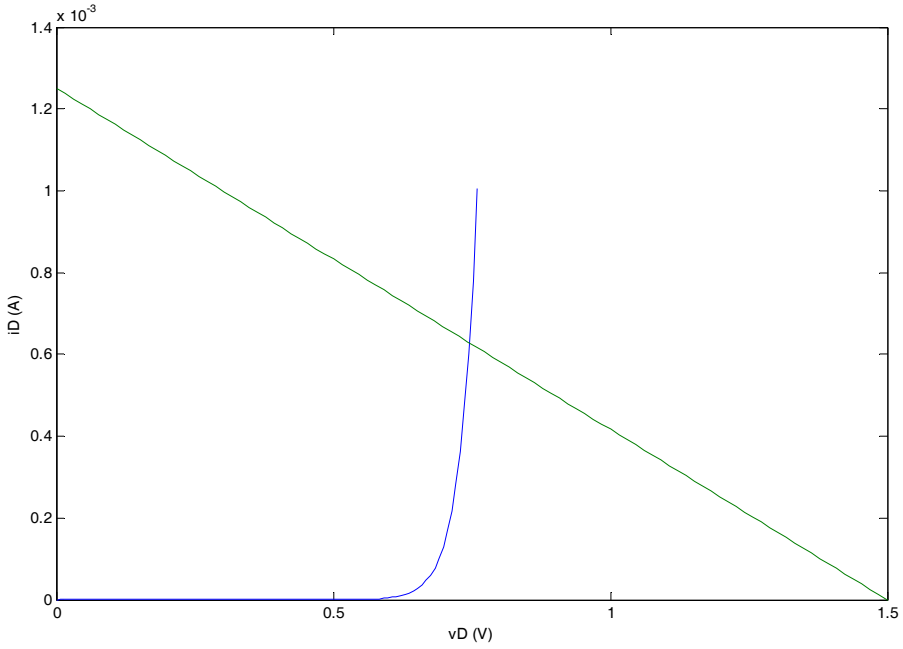
Script File:

```
F0=12; wn=10; w=12;
t=linspace(0,10,1000);
x=2*F0*sin((wn-w)*t/2).*sin((wn+w)*t/2)./(wn^2-w^2);
plot(t,x)
xlabel('Time (s)')
ylabel('Position (m)')
```



Problem 27

```
I0=1E-14; K=30E-3;
vS=1.5;R=1200;
vD1=linspace(0,0.76,100);
vD2=linspace(0,1.5,100);
iD1=I0*(exp(vD1/K)-1);
iD2=-vD2/R+vS/R;
plot(vD1,iD1,vD2,iD2)
xlabel('vD (V)')
ylabel('iD (A)')
```



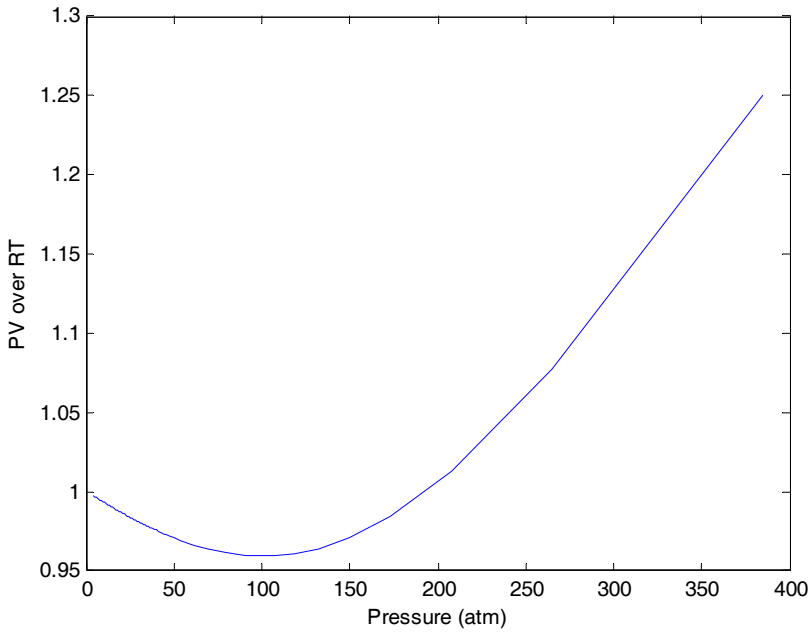
Estimate:

$v_D = 0.75$ V, $i_D = 0.61$ A

Problem 28

Script File:

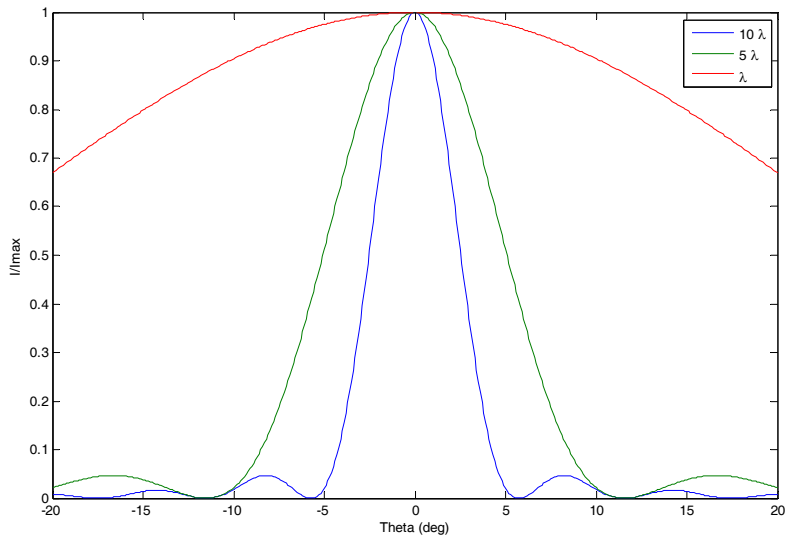
```
R=0.08208;
a=1.39; b=0.0391; n=1;
T=300;
V=0.08:0.02:6;
p=n*R*T./(V-n*b)-n^2*a./V.^2;
PVRT=p.*V/(R*T);
plot(p,PVRT);
xlabel('Pressure (atm)')
ylabel('PV over RT')
```



The response does not agree with the ideal gas equation.

Problem 29

```
th=-20:0.1:20;
aL1=pi*10*sind(th);
Ith1=(sin(aL1)./aL1).^2;
aL2=pi*5*sind(th);
Ith2=(sin(aL2)./aL2).^2;
aL3=pi*sind(th);
Ith3=(sin(aL3)./aL3).^2;
plot(th,Ith1,th,Ith2,th,Ith3)
xlabel('Theta (deg)')
ylabel('I/Imax')
legend('10 \lambda','5 \lambda','\lambda')
```



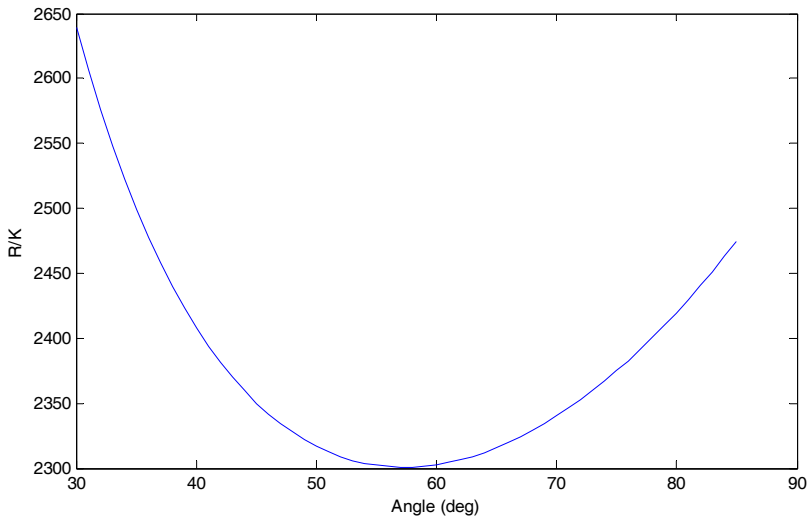
Problem 30

Script file:

```
d1=0.875; d2=0.75;
L1=50*12; L2=40*12;
th=30:1:85;
R=(L1-L2*cotd(th))/d1^4+L2./(d2^4*sind(th));
plot(th,R)
[Rmin el]=min(R);
Rmin
ThetaofRmin=th(el)
s=L2/tand(th(el))/12
xlabel('Angle (deg)')
ylabel('R/K')
```

Command Window:

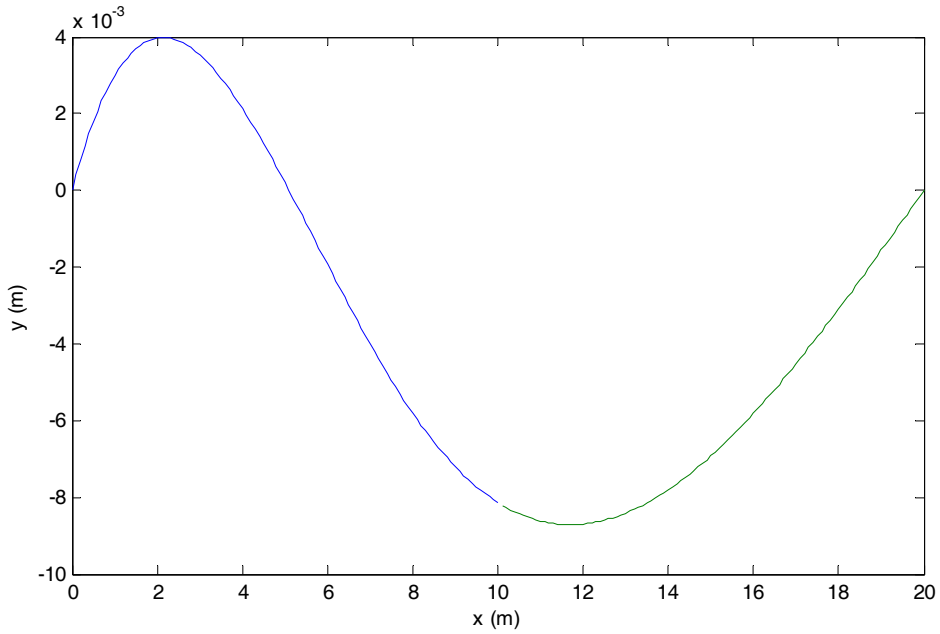
```
Rmin =
  2.3007e+003
ThetaofRmin =
    57
s =
   25.9763
```



Problem 31

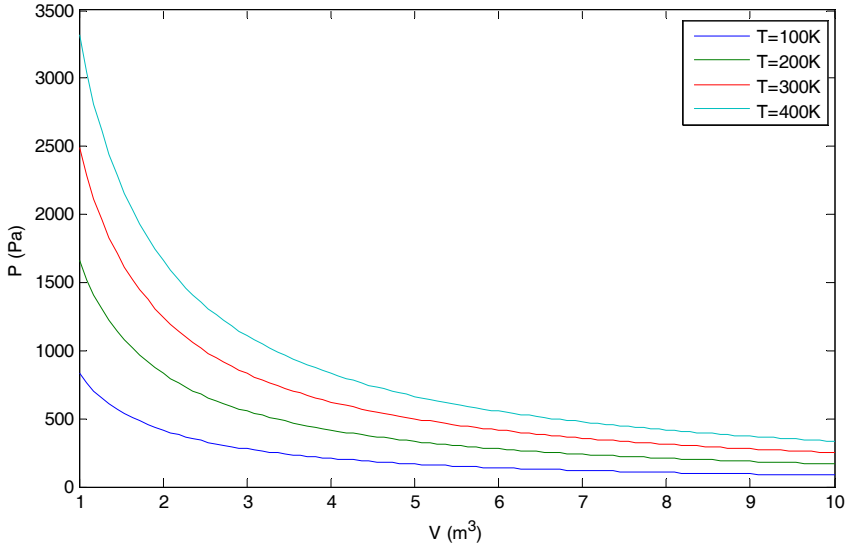
Script File:

```
EI=200E9*384E-6;
L=20; w=5400; M=200000;
x1=0:0.1:10;
x2=10.1:0.1:20;
K1=w/(384*EI);
K2=M/(6*EI*L);
y1=-K1*x1.*(16*x1.^3-24*L*x1.^2+9*L^3)+K2*x1.*(x1.^2-
3*L*x1+2*L^2);
y2=-K1*L*(8*x2.^3-24*L*x2.^2+17*L^2*x2-L^3)+K2*x2.*(x2.^2-
3*L*x2+2*L^2);
plot(x1,y1,x2,y2)
xlabel('x (m)')
ylabel('y (m)')
```



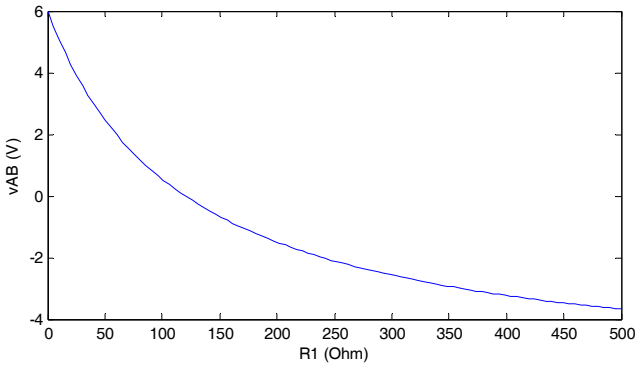
Problem 32

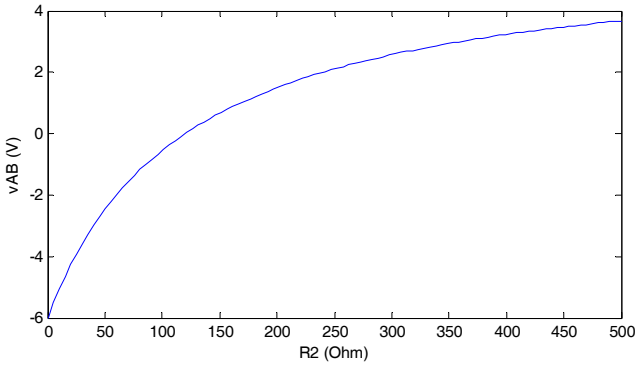
```
R=8.3145;
T=[100:100:400];
V=linspace(1,10,100);
p1=R*T(1)./V;
p2=R*T(2)./V;
p3=R*T(3)./V;
p4=R*T(4)./V;
plot(V,p1,V,p2,V,p3,V,p4)
xlabel('V (m^3)')
ylabel('P (Pa)')
legend('T=100K','T=200K','T=300K','T=400K')
```



Problem 33

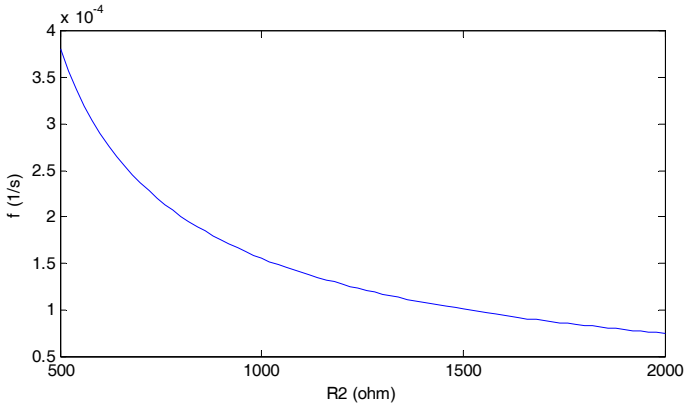
```
V=12; R2=120; R3=250; R4=250;
R1=linspace(0,500,100);
VABa=V*(R2./(R1+R2)-R4/(R3+R4));
subplot(2,1,1)
plot(R1,VABa)
xlabel('R1 (Ohm)')
ylabel('vAB (V)')
R1b=120;
R2b=linspace(0,500,100);
VABb=V*(R2b./(R1b+R2b)-R4/(R3+R4));
subplot(2,1,2)
plot(R2b,VABb)
xlabel('R2 (Ohm)')
ylabel('vAB (V)')
```

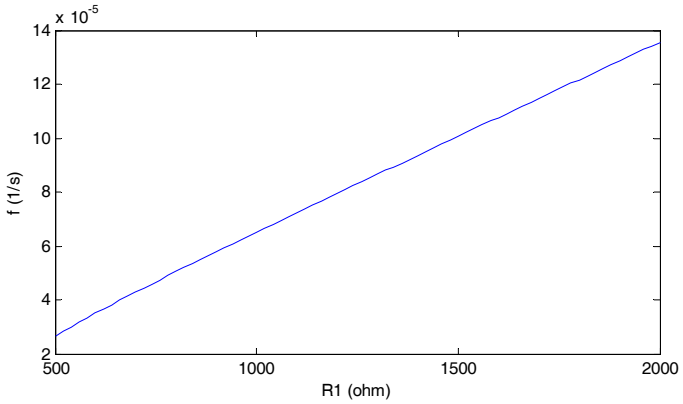




Problem 34

```
L=0.2; C=2E-6;
LC=L*C;
% Part a
R1a=1500;
R2a=500:20:2000;
fa=1/(2*pi)*sqrt(LC*(R1a^2*C-L)./(R2a.^2*C-L));
subplot(2,1,1)
plot(R2a,fa)
xlabel('R2 (ohm)')
ylabel('f (1/s)')
% Part b
R2b=1500;
R1b=500:20:2000;
fb=1/(2*pi)*sqrt(LC*(R1b.^2*C-L)./(R2b^2*C-L));
subplot(2,1,2)
plot(R1b,fb)
xlabel('R1 (ohm)')
ylabel('f (1/s)')
```


x 10^-4
4
3.5
3
2.5
2
1.5
1
0.5
f (1/s)
500
1000
1500
2000
R2 (ohm)


x 10^-5
14
12
10
8
6
4
2
f (1/s)
500
1000
1500
2000
R1 (ohm)

Problem 35

```
x=linspace(-2*pi,2*pi);
x2=linspace(-pi,1*pi,100);
x5=linspace(-2*pi,2*pi,100);
x7=linspace(-2*pi,2*pi,100);
f5=factorial(5);
f7=factorial(7);
f9=factorial(9);
f11=factorial(11);
f13=factorial(13);
y=sin(x);
y1=x;
y2=x2-x2.^3/6;
y5=x5-x5.^3/6+x5.^5/f5-x5.^7/f7+x5.^9/f9;
y7=x7-x7.^3/6+x7.^5/f5-x7.^7/f7+x7.^9/f9-x7.^11/f11+x7.^13/
f13;
plot(x,y,x,y1,'-.',x2,y2,'.',x5,y5,'--')
%plot(x,y,x2,y2,x4,y4,x6,y6)
axis([-8 8 -2 2])
```