Chapter 11
Solved Problems

Problem 1

Script file:

```
syms x
S1=x^2*(x-6)+4*(3*x-2)
S2=(x+2)^2-8*x
disp('Part (a)')
a=simple(S1*S2)
disp('Part (b)')
b=simple(S1/S2)
disp('Part (c)')
c=simple(S1+S2)
disp('Part (d)')
d=subs(c,5)
```

Command Window:

```
S1 =
12*x + x^2*(x - 6) - 8
S2 =
(x + 2)^2 - 8*x
Part (a)
a =
(x - 2)^5
Part (b)
b =
x - 2
Part (c)
c =
```

```
(x - 1)*(x - 2)^2
Part (d)
d =
   36
```

Problem 2

Script File:

```
syms x
S1=x*(x^2+6*x+12)+8
S2=(x-3)^2+10*x-5
disp('Part (a)')
a=simple(S1*S2)
disp('Part (b)')
b=simple(S1/S2)
disp('Part (c)')
c=simple(S1+S2)
disp('Part (d)')
d=subs(c,3)
```

Command Window:

```
S1 =
x*(x^2 + 6*x + 12) + 8
S2 =
10*x + (x - 3)^2 - 5
Part (a)
a =
(x + 2)^5
Part (b)
b =
x + 2
Part (c)
c =
(x + 2)^2*(x + 3)
Part (d)
d =
   150
```

Problem 3

Script File:

```
syms x y
T=sqrt(x)-y^2;
S=x+sqrt(x)*y^2+y^4;
Q=S*T
QS=simplify(Q)
subs(QS,{x,y},{9,2})
```

Command Window:

```
Q =
(x^(1/2) - y^2)*(x + x^(1/2)*y^2 + y^4)
QS =
x^(3/2) - y^6
ans =
   -37
```

Problem 4

Script File:

```
syms x y
% Part (a)
Sa=(x+2)*(x+0.5)*(x-2)*(x-4.5);
disp('Part (a)')
P=expand(Sa)
% Part (b)
Sp=x^6 - 6.5*x^5 - 58*x^4 + 167.5*x^3 + 728*x^2 - 890*x -
1400;
disp('Part (b)')
SpFF=factor(Sp)
```

Command Window:

```
Part (a)
P =
x^4 - 4*x^3 - (25*x^2)/4 + 16*x + 9
Part (b)
SpFF =
((x - 2)*(2*x + 7)*(x - 4)*(x + 5)*(x - 10)*(x + 1))/2
```

The roots are: 2, -3.5, 4, -5, 10, and -1

Problem 5

Command Window:

```
>> syms x
>> % Part (a)
>> aRHS=4*sin(x)*cos(x)-8*sin(x)^3*cos(x)
aRHS =
4*cos(x)*sin(x) - 8*cos(x)*sin(x)^3
>> a=simple(aRHS)
a =
sin(4*x)
>> % Part (b)
>> syms x y
>> bRHS=(cos(x-y)+cos(x+y))/2
bRHS =
cos(x - y)/2 + cos(x + y)/2
>> b=simple(bRHS)
b =
cos(x)*cos(y)
```

Problem 6

```
>> syms x
>> aRHS=(3*tan(x)-tan(x)^3)/(1-3*tan(x)^2)
aRHS =
-(3*tan(x) - tan(x)^3)/(3*tan(x)^2 - 1)
>> a=simple(aRHS)
a =
tan(3*x)
>> syms x y z
>>
bRHS=sin(x)*cos(y)*cos(z)+cos(x)*sin(y)*cos(z)+cos(x)*
cos(y)*sin(z)-sin(x)*sin(y)*sin(z)
bRHS =
cos(x)*cos(y)*sin(z)    +    cos(x)*cos(z)*sin(y)    +
cos(y)*cos(z)*sin(x) - sin(x)*sin(y)*sin(z)
>> b=simple(bRHS)
b =
sin(x + y + z)
```

Problem 7

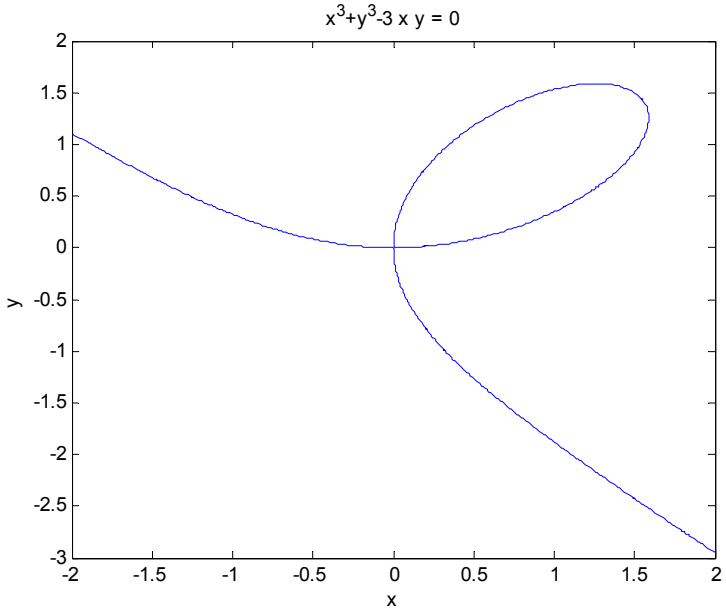
Script File:

```
syms xs ys t
xs=3*t/(1+t^3)
ys=3*t^2/(1+t^3)
fL=xs^3+ys^3
fLS=simple(fL)
fR=3*xs*ys
ezplot('x^3+y^3-3*x*y',[-2,2,-3,2])
```

Command Window:

```
xs =
3*t/(1+t^3)
ys =
3*t^2/(1+t^3)
fL =
27*t^3/(1+t^3)^3+27*t^6/(1+t^3)^3
fLS =
27*t^3/(1+t^3)^2
fR =
27*t^3/(1+t^3)^2
```

Figure Window:



Problem 8

Script file:

```
syms V r h
Vt=pi*(r^2*h+2*r^3/3)
Vth=subs(Vt,h,10)
rs=double(solve(Vth-1050,r))
```

Command Window:

```
Vt =
pi*((2*r^3)/3 + h*r^2)
Vth =
pi*((2*r^3)/3 + 10*r^2)
rs =
   5.0059
 -10.0030 + 0.2986i
 -10.0030 - 0.2986i
```

The radius is 5.0059 m.

Problem 9

Script file:

```
clear
eqn1='(T+a)*(v+b)=(T0+a)*b'
eqn2=subs(eqn1,'T',0)
disp('Answer to part a:')
vmax=solve(eqn2,'v')
eqn3=subs(eqn1,'b','vmax*a/T0')
disp('Answer to part b:')
v=solve(eqn3,'v')
```

Command Window:

```
eqn1 =
(T+a)*(v+b)=(T0+a)*b
eqn2 =
a*(v+b) = (T0+a)*b
Answer to part a:
vmax =
b*T0/a
eqn3 =
(T+a)*(v+(vmax*a/T0))=(T0+a)*(vmax*a/T0)
Answer to part b:
v =
-vmax*a*(T-T0)/T0/(T+a)
```

Problem 10

Script File:

```
syms x y
ezplot('(x-1)^2/6^2+y^2/3^2=1',[-8,8,-4,10])
hold on
ezplot('(x+2)^2/2^2+(y-5)^2/4^2=1',[-8,8,-4,10])
axis equal
xlabel('x')
ylabel('y')
hold off
[xs,ys]=solve('(x-1)^2/6^2+y^2/3^2=1','(x+2)^2/2^2+(y-5)^2/
4^2=1')
```

Command Window:

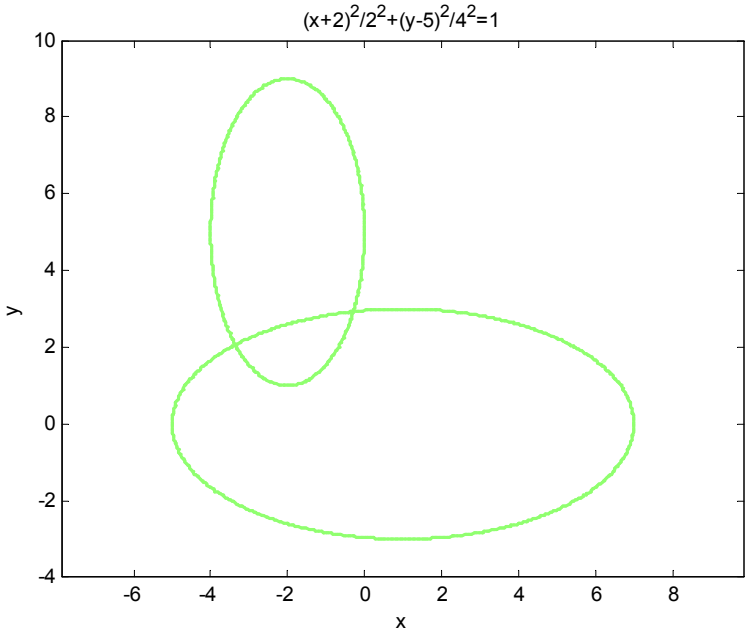
```
xs =
                                                                -
0.28863594242289174161458727944367
                                                                -
3.35740309554973140623040357251l4
        -        3.56880082155560393892126349555543*i        -
2.57698048101368842607750457402 25
                  3.56880082155560393892126349555543*i       -
2.57698048101368842607750457402 25
ys =

2.92999221022411020505670527359 77

2.06234322209553775773065526556 63
                   1.00902618776405850552842550789 8*i       -
3.16283438282649064806034693624 87
        -        1.00902618776405850552842550789 8*i        -
3.16283438282649064806034693624 87
```

Intersection points:
(-0.2886359424, 2.9299922102) and (-3.3574030955, 2.0623432220)

Figure:


(x+2)^2/2^2+(y-5)^2/4^2=1
10
8
6
4
2
0
-2
-4
y
-6
-4
-2
0
2
4
6
8
x

Problem 11

Script file:

```
syms T W FAx FAy d h L Lc
eq1 = 'FAx-T*d/Lc=0';
eq2 = 'FAy+T*sqrt(Lc^2-d^2)/Lc-W=0';
eq3 = 'T*sqrt(Lc^2-d^2)*d/Lc-W*L=0';
disp('Part a')
[FAx FAy T]=solve(eq1,eq2,eq3,FAx,FAy,T)
disp('Part b')
FAxN = subs(FAx,{W,L, Lc},{200, 120,66})
FAyN = subs(FAy,{W,L, Lc},{200, 120,66})
TN = subs(T,{W,L, Lc},{200, 120,66})
FAN=sqrt(FAxN^2+FAyN^2)
ezplot(TN,[20,70])
TNd=diff(TN)
dFmin=double(solve(TNd))
Tmin=subs(TN,dFmin)
hold on
ezplot(FAN,[20,70])
legend('T','FA',2)
xlabel('d (in.)')
ylabel('Force (lb)')
hold off
```

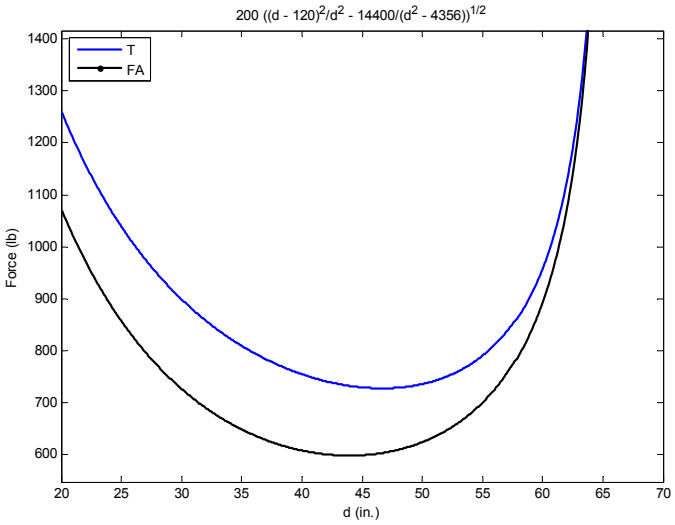
Command Window:

```
Part a
FAx =
(L*W)/(Lc^2 - d^2)^(1/2)
FAy =
-(W*(L - d))/d
T =
(L*Lc*W)/(d*(Lc^2 - d^2)^(1/2))
Part b
FAxN =
24000/(4356 - d^2)^(1/2)
FAyN =
(200*(d - 120))/d
TN =
```

```
1584000/(d*(4356 - d^2)^(1/2))
FAN =
200*((d - 120)^2/d^2 - 14400/(d^2 - 4356))^(1/2)
TNd =
1584000/(4356 - d^2)^(3/2) - 1584000/(d^2*(4356 - d^2)^(1/
2))
dFmin =
   46.6690
  -46.6690
Tmin =
  727.2727
 -727.2727
```

The smalles tension in the cable is 727.2727 lb at d = 46.669 in.

Figure Window:



The line style was formated in the Figure Window.

Problem 12

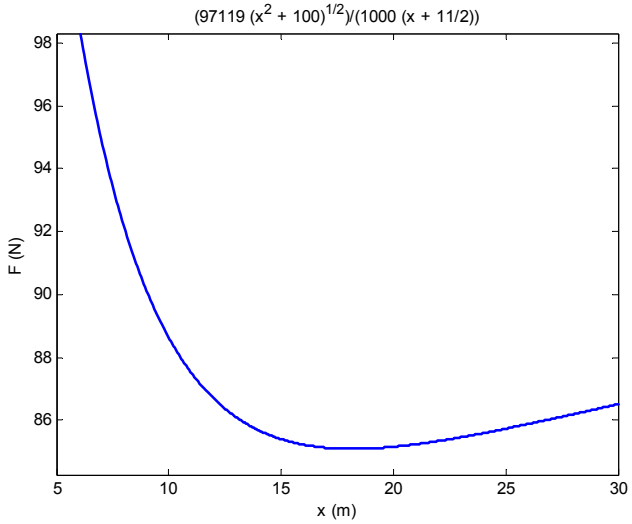
Script file:

```
syms F N x m g h mew
eq1 = '-F*x/sqrt(x^2+h^2)+mew*N=0';
eq2 = '-m*g+N+F*h/sqrt(x^2+h^2)=0';
disp('Part a')
[F N]=solve(eq1,eq2,F,N)
Fs=simple(F)
Ns=simple(N)
disp('Part b')
Fx = subs(F,{m,g,h,mew},{18,9.81,10,0.55})
Fd = diff(Fx)
xFmin=double(solve(Fd))
Fmin=double(subs(Fx,x,xFmin))
ezplot(Fx,[5,30])
xlabel('x (m)')
ylabel('F (N)')c
```

Command Window:

```
Part a
F =
(g*m*mew*(h^2 + x^2)^(1/2))/(x + h*mew)
N =
(g*m*x)/(x + h*mew)
Fs =
(g*m*mew*(h^2 + x^2)^(1/2))/(x + h*mew)
Ns =
(g*m*x)/(x + h*mew)
Part b
Fx =
(97119*(x^2 + 100)^(1/2))/(1000*(x + 11/2))
Fd =
(97119*x)/(1000*(x^2 + 100)^(1/2)*(x + 11/2)) - (97119*(x^2
+ 100)^(1/2))/(1000*(x + 11/2)^2)
xFmin =
   18.1818
Fmin =
   85.0972
```

Figure Window:

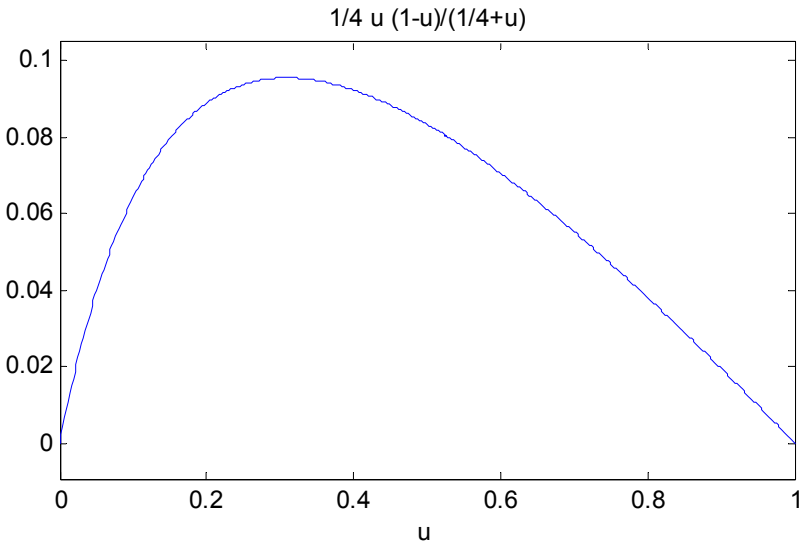


Problem 13

Command Window:

```
>> k=0.25;
>> syms u
>> p=k*u*(1-u)/(k+u)
p =
1/4*u*(1-u)/(1/4+u)
>> % Part a
>> ezplot(p,[0,1])
>> % Part b
>> dp=diff(p,u)
dp =
1/4*(1-u)/(1/4+u)-1/4*u/(1/4+u)-1/4*u*(1-u)/(1/4+u)^2
>> uMaxMin=solve(dp,u)
uMaxMin =
 -1/4*5^(1/2)-1/4
  1/4*5^(1/2)-1/4
>> double(uMaxMin)
ans =
   -0.8090
    0.3090
>> pMax=subs(p,u,uMaxMin(2))
pMax =
1/5*(1/4*5^(1/2)-1/4)*(5/4-1/4*5^(1/2))*5^(1/2)
>> pMaxNumber=double(pMax)
pMaxNumber =
    0.0955
```

Figure:



Problem 14

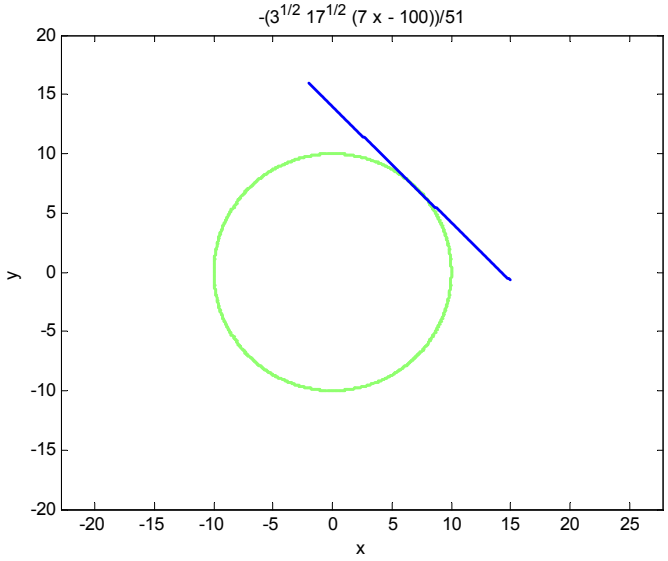
Script File:

```
syms R
syms x y x0 y0
C=x^2+y^2-R^2;
% The equation of circle in the form y=f(x)
yC=solve(C,y);
yCp=yC(1);   % Taking the solution for y>0
slope=diff(yCp,x);
Spx0=subs(slope,x,x0);  % The tangent to the ellipse at x=x0
y0=subs(yCp,x,x0);  % The value of y0 at x0
bL=y0-Spx0*x0;  % The value of b in the equation of the line
(y=mx+b)
y=Spx0*x+bL;  % The equation of the line
ys=simplify(y)  % The equation of the line
Eab=subs(C,R,10);
yx0=subs(ys,{R,x0},{10,7});
ezplot(Eab,[-15 15])
hold on
ezplot(yx0,[-2 15])
axis([-20 20 -20 20])
axis equal
hold off
```

Command Window:

```
ys =
-(x*x0 - R^2)/((R + x0)^(1/2)*(R - x0)^(1/2))
```

Figure:



Problem 15

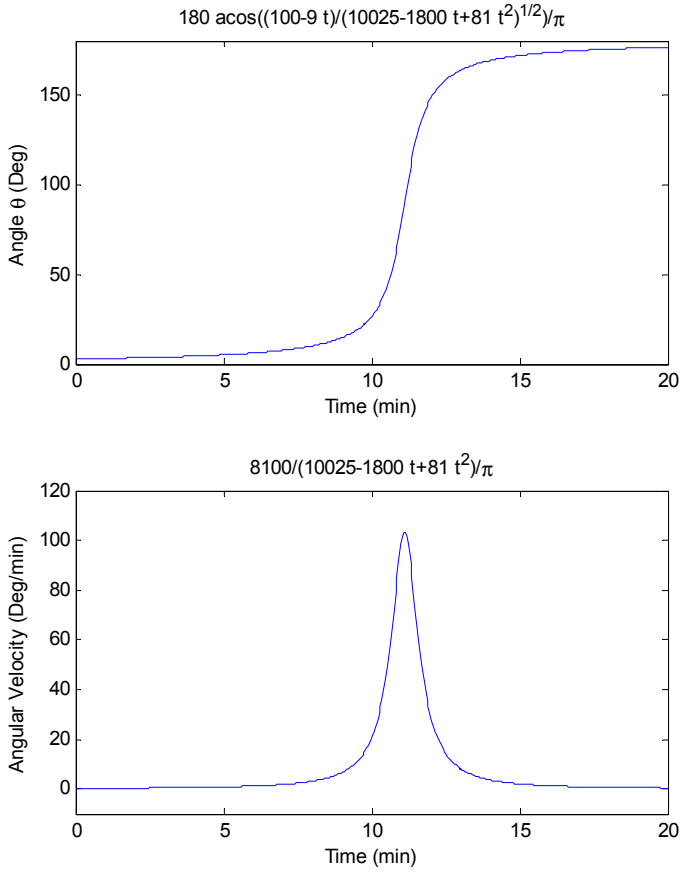
Script file:

```
syms x t
v=540*1000/60; h=5000;
x=100000-v*t
s=sqrt(x^2+h^2)
q=simple(acos(x/s))
qt=simple(diff(q,t))
subplot(2,1,1)
qdeg=q*180/pi;
ezplot(qdeg,[0,20])
axis([0,20,0,180])
xlabel('Time (min)')
ylabel('Angle \theta (Deg)')
subplot(2,1,2)
qtdeg=qt*180/pi;
ezplot(qtdeg,[0,20])
axis([0,20,-10,120])
xlabel('Time (min)')
ylabel('Angular Velocity (Deg/min)')
```

Command Window:

```
x =
100000-9000*t
s =
1000*(10025-1800*t+81*t^2)^(1/2)
q =
acos((100-9*t)/(10025-1800*t+81*t^2)^(1/2))
qt =
45/(10025-1800*t+81*t^2)
```

Figure:


180 acos((100-9 t)/(10025-1800 t+81 t^2)^1/2)/π
Angle θ (Deg)
Time (min)
8100/(10025-1800 t+81 t^2)/π
Angular Velocity (Deg/min)
Time (min)

Problem 16

Script file:

```
syms x
Sa=x^3/sqrt(1-x^2)
ISa=int(Sa)
Sb=x^2*cos(x)
ISb=int(Sb)
```

Command Window:

```
Sa =
x^3/(1 - x^2)^(1/2)
ISa =
-((1 - x^2)^(1/2)*(x^2 + 2))/3
Sb =
x^2*cos(x)
ISb =
x^2*sin(x) - 2*sin(x) + 2*x*cos(x)
```

Problem 17

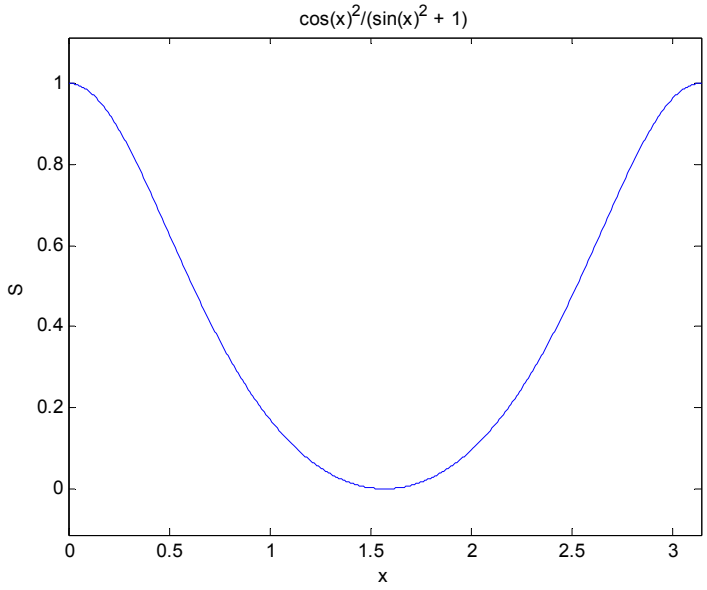
Script file:

```
syms x
Sa=cos(x)^2/(1+sin(x)^2)
ezplot(Sa,[0,pi])
ylabel('S')
ISaa=int(Sa)
ISa=int(Sa,0,pi)
```

Command Window:

```
Sa =
cos(x)^2/(sin(x)^2 + 1)
ISaa =
2^(1/2)*atan(2^(1/2)*tan(x)) - x
ISa =
pi*(2^(1/2) - 1)
```

Figure:



Problem 18

The area at a given z is $\pi a \ \sin v b \ \sin v$
also: $z = c \ \cos v \qquad dz = c \ (-\sin v) dv$

Than: $dV = -\pi abc \sin^3 v dv$

Script file:

```
syms x
Sa=sin(x)^3
ISaa=int(Sa)
ISa=-int(Sa,-pi,0)
```

Command Window:

```
Sa =
sin(x)^3
ISaa =
cos(3*x)/12 - (3*cos(x))/4
ISa =
4/3
```

So, the volume is: $\frac{4}{3}\pi abc$

Problem 19

(*a*)
Script File:

```
syms x w a t c A B C m
S=A*exp(-x^2/(4*m*t))/sqrt(t)+B
Sdt=diff(S,t)
Sddx=diff(S,x,2)
E=Sdt-m*Sddx
simplify(E)
```

Command Window:

```
S =
B + A/(t^(1/2)*exp(x^2/(4*m*t)))
Sdt =
(A*x^2)/(4*m*t^(5/2)*exp(x^2/(4*m*t))) - A/(2*t^(3/
2)*exp(x^2/(4*m*t)))
Sddx =
(A*x^2)/(4*m^2*t^(5/2)*exp(x^2/(4*m*t))) - A/
(2*m*t^(3/2)*exp(x^2/(4*m*t)))
E =
m*(A/(2*m*t^(3/2)*exp(x^2/(4*m*t))) - (A*x^2)/
(4*m^2*t^(5/2)*exp(x^2/(4*m*t)))) - A/(2*t^(3/
2)*exp(x^2/(4*m*t))) + (A*x^2)/(4*m*t^(5/2)*exp(x^2/
(4*m*t)))
ans =
0
```

(*b*)
Script File:

```
syms x w a t c A B C m
S=A*exp(-a*x)*cos(a*x-2*m*a^2*t+B)+C
Sdt=diff(S,t)
Sddx=diff(S,x,2)
E=Sdt-m*Sddx
simplify(E)
```

Command Window:

```
S =
C + (A*cos(- 2*m*t*a^2 + x*a + B))/exp(a*x)
Sdt =
(2*A*a^2*m*sin(- 2*m*t*a^2 + x*a + B))/exp(a*x)
```

```
Sddx =
(2*A*a^2*sin(- 2*m*t*a^2 + x*a + B))/exp(a*x)
E =
0
ans =
0
```

Problem 20

Script File:

```
syms k x y
y=-k*x^2+12*k*x;
Ared=int(y,x,0,12);
Awhite=180-Ared;
equation=Ared-Awhite;
ks=solve(equation)
```

Command Window:

```
ks =
5/16
```

Problem 21

Script File:

```
syms R x y
x=sqrt(R^2-y^2);
A=2*int(x,y,0,R);
xy=y*x;
Ax=2*int(xy,y,0,R);
ybar=Ax/A
```

Command Window:

```
ybar =
(4*R)/(3*pi)
```

Problem 22

Script File:

```
syms R x y
x=sqrt(R^2-y^2);
xy2=2*x*y^2;
I=int(xy2,y,0,R)
```

Command Window:

```
I =
(pi*R^4)/8
```

Problem 23

Part *a*):
Script file:

```
syms w t T V
vt=V*cos(w*t)
vt2=vt^2
vrms=sqrt(int(vt2,t,0,T)/T)
vrmsANS=subs(vrms,T,2*pi/w)
```

Command Window:

```
vt =
V*cos(w*t)
vt2 =
V^2*cos(w*t)^2
vrms =
1/2*2^(1/2)*(V^2*(cos(w*T)*sin(w*T)+w*T)/w/T)^(1/2)
vrmsANS =
1/2*2^(1/2)*(V^2)^(1/2)
```

Part *b*):
Script file:

```
syms w t T V
vt=2.5*cos(w*t)+3
vt2=vt^2
vrms=sqrt(int(vt2,t,0,T)/T)
vrmsANS=subs(vrms,T,2*pi/w)
vrmsNUMBER=double(vrmsANS)
```

Command Window:

```
vt =
5/2*cos(w*t)+3
vt2 =
(5/2*cos(w*t)+3)^2
vrms =
1/4*2^(1/2)*((25*cos(w*T)*sin(w*T)+97*w*T+120*sin(w*T))/w/
T)^(1/2)
vrmsANS =
1/4*194^(1/2)
vrmsNUMBER =
    3.4821
```

Problem 24

Script File:

```
clear
syms x N R t
x=dsolve('Dx=-R*x*(N+1-x)','x(0)=N')
t_max=solve(diff(x,2),t)
```

Command Window:

```
x =
exp(-R*(N+1)*t)*N*(N+1)/(1+exp(-R*(N+1)*t)*N)
t_max =
log(N)/R/(N+1)
```

Problem 25

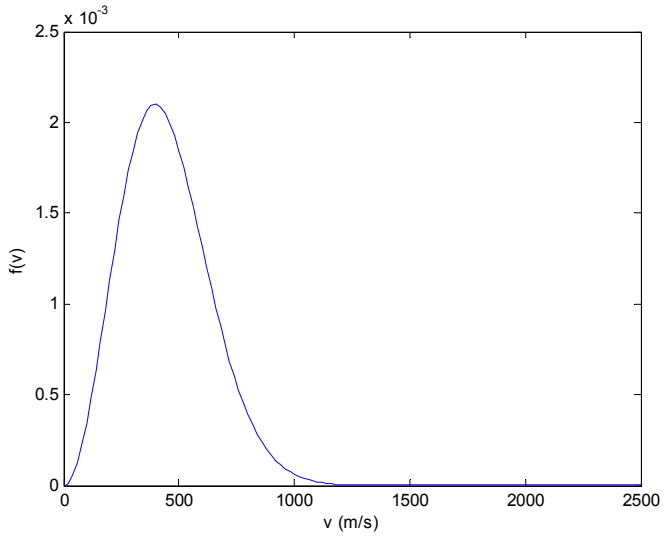
Script File:

```
m=5.3E-26;
kB=1.38E-23;
T1=300;
v=0:20:2500;
k=m/(kB*T1);
K3=sqrt(k^3*2/pi);
vsq=v.^2;
Fv=K3*vsq.*exp(-k/2*vsq);
plot(v,Fv)
xlabel('v (m/s)')
ylabel('f(v)')
syms M K T V
S=sqrt(2*(M/(K*T))^3/pi)*V^2*exp(-M*V^2/(2*K*T))
Sd=diff(S,V)
VP=solve(Sd,V)
VPn=double(subs(VP(2),{K M T},{1.38E-23,5.3E-26,300}))
```

Command Window:

```
S =
(2^(1/2)*V^2*(M^3/(K^3*T^3))^(1/2))/(pi^(1/
2)*exp((M*V^2)/(2*K*T)))
Sd =
(2*2^(1/2)*V*(M^3/(K^3*T^3))^(1/2))/(pi^(1/
2)*exp((M*V^2)/(2*K*T))) - (2^(1/2)*M*V^3*(M^3/
(K^3*T^3))^(1/2))/(K*pi^(1/2)*T*exp((M*V^2)/(2*K*T)))
VP =
                              0
  (2^(1/2)*(K*M*T)^(1/2))/M
 -(2^(1/2)*(K*M*T)^(1/2))/M
VPn =
  395.2549
```

Figure:



Problem 26

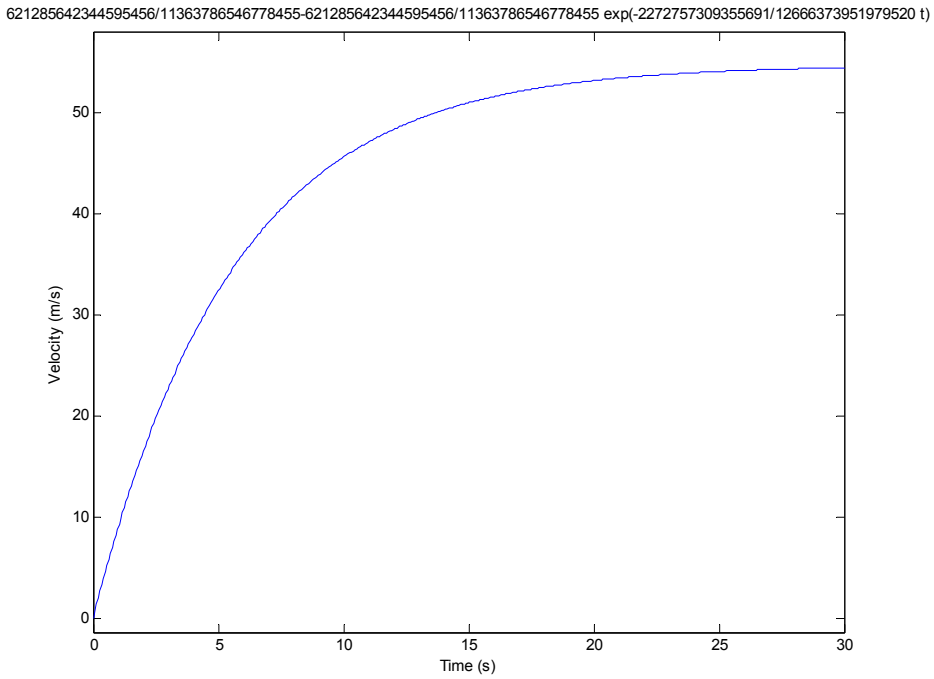
Script file:

```
syms m g c v t
disp('Answer to Part a:')
vs=dsolve('m*g-c*v=m*Dv','v(0)=0')
vsn=subs(vs,{m,g,t},{90,9.81,4});
vsneq=vsn-28;
disp('Answer to Part b:')
cs=double(solve(vsneq))
disp('Velocity as a function of time:')
vst=subs(vs,{m,g,c},{90,9.81,cs(1)})
ezplot(vst,[0,30])
xlabel('Time (s)')
ylabel('Velocity (m/s)'
```

Command Window:

```
Answer to Part a:
vs =
g/c*m-exp(-c/m*t)*g/c*m
Answer to Part b:
cs =
   16.1489
         0
Velocity as a function of time:
vst =
621285642344595456/11363786546778455-621285642344595456/
11363786546778455*exp(-2272757309355691/12666373951979520*t)
```

Figure:


621285642344595456/11363786546778455-621285642344595456/11363786546778455 exp(-2272757309355691/12666373951979520 t)
Velocity (m/s)
Time (s)
0
10
20
30
40
50
0
5
10
15
20
25
30

Problem 27

Script file for Parts *a* and *b*, and one plot in part *d*:

```
syms v R L I t
disp('Answer to Part a:')
Ia=dsolve('R*I+L*DI=v','I(0)=0')
Iat=subs(Ia,{v, R, L},{6, 0.4, 0.08});
Va_in_Rt=Iat*0.4;
Equation=Va_in_Rt-5;
timeVis5=solve(Equation);
disp('Answer to Part b:')
tBA=double(timeVis5)
disp('Current at tBA:')
I_at_tBA=subs(Iat,t,tBA)
subplot(1,2,1)
ezplot(Va_in_Rt,[0,tBA])
xlabel('Time (s)')
ylabel('Voltage Across R (V)')
```

Command Window:

```
Answer to Part a:
Ia =
1/R*v-exp(-R/L*t)/R*v
Answer to Part b:
tBA =
    0.3584
Current at tBA:
I_at_tBA =
   12.5000
```

Use the values of tBA and I_at_tBA for the initial condition in the solution of Part *c*.

Script file for Part *c*, and the second plot in part *d*:

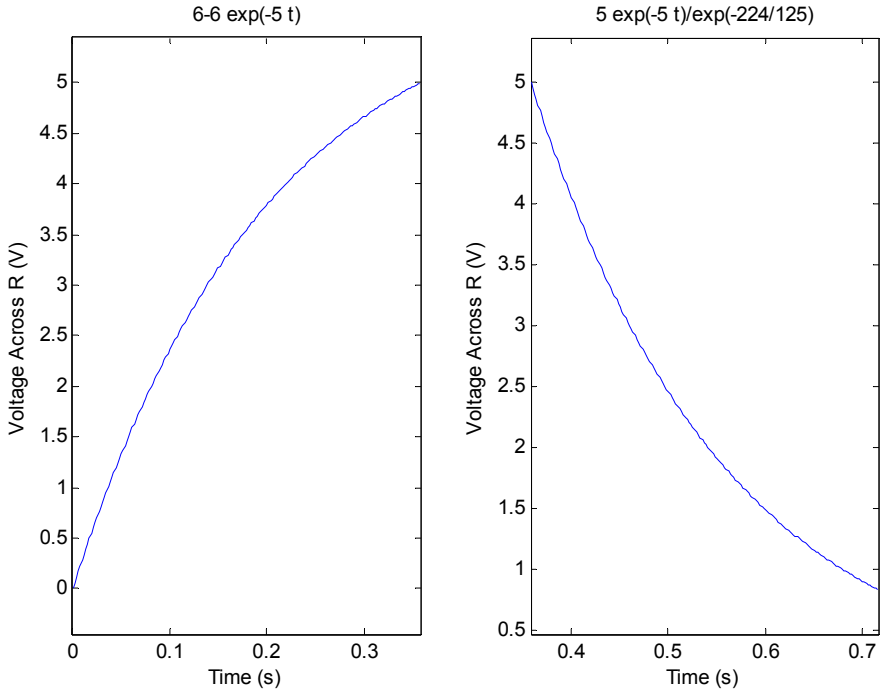
```
syms v R L I t
disp('Answer to Part c:')
Ic=dsolve('R*I+L*DI=0','I(0.3584)=12.5')
Ict=subs(Ic,{R, L},{0.4, 0.08});
Vc_in_Rt=Ict*0.4;
subplot(1,2,2)
ezplot(Vc_in_Rt,[tBA,2*tBA])
```

```
xlabel('Time (s)')
ylabel('Voltage Across R (V)')
```

Command Window:

```
Answer to Part c:
Ic =
25/2*exp(-R/L*t)/exp(-224/625*R/L)
```

Figure:



Problem 28

Script file:

```
syms x y
ys=dsolve('Dy=(x^4-2*y)/(2*x)','x')
yd=diff(ys)
Equation=simplify(yd-(x^4-2*ys)/(2*x))
```

Command Window:

```
ys =
C5/x + x^4/10
yd =
(2*x^3)/5 - C5/x^2
Equation =
0
```

Problem 29

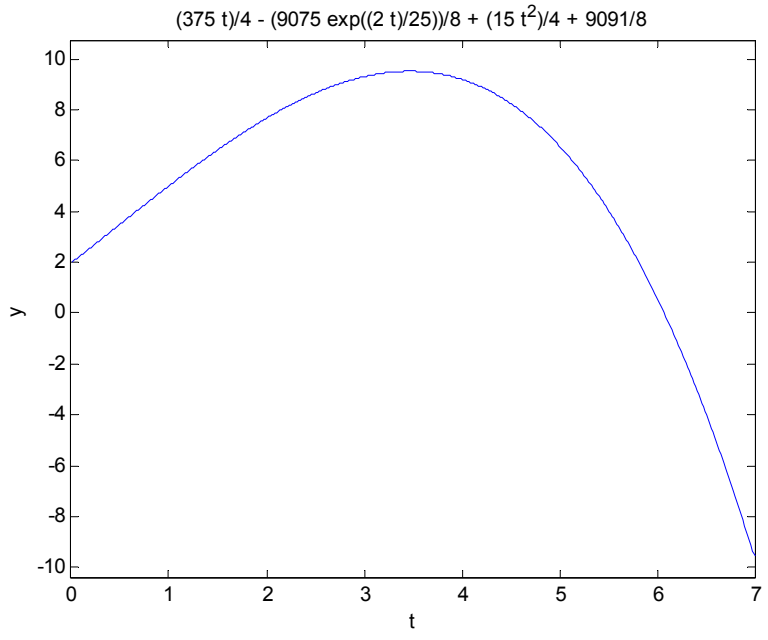
Script file:

```
syms x y t
ys=dsolve('D2y-0.08*Dy+0.6*t=0','y(0)=2','Dy(0)=3')
ezplot(ys,[0,7])
xlabel('t')
ylabel('y')
```

Command Window:

```
ys =
(375*t)/4 - (9075*exp((2*t)/25))/8 + (15*t^2)/4 + 9091/
8
```

Figure:



Problem 30

Script file:

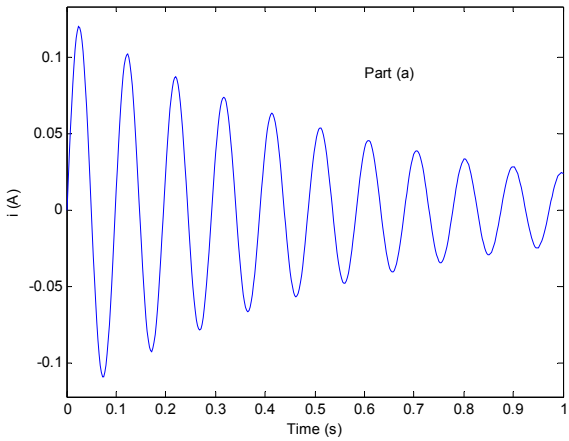
```
syms i t R C L
% Part a
i=dsolve('L*D2i+R*Di+1/C*i=10','i(0)=0','Di(0)=8')
isim=simple(i)
% Part b
iNb=subs(i,{L,R,C},{3,10,80E-6})
ezplot(iNb,[0,1])
xlabel('Time (s)')
ylabel('i (A)')
text(0.6,0.09,'Part (a)')
% Part c
iNc=subs(i,{L,R,C},{3,200,1200E-6})
figure
ezplot(iNc,[0,1])
xlabel('Time (s)')
ylabel('i (A)')
text(0.6,0.09,'Part (b)')
% Part d
iNd=subs(i,{L,R,C},{3,201,300E-6})
figure
ezplot(iNd,[0,3])
xlabel('Time (s)')
ylabel('i (A)')
text(0.6,0.09,'Part (c)')
axis([0 1 0 0.1])
```

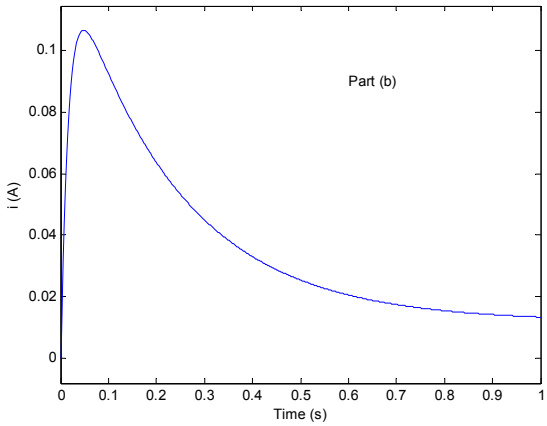
Command Window:

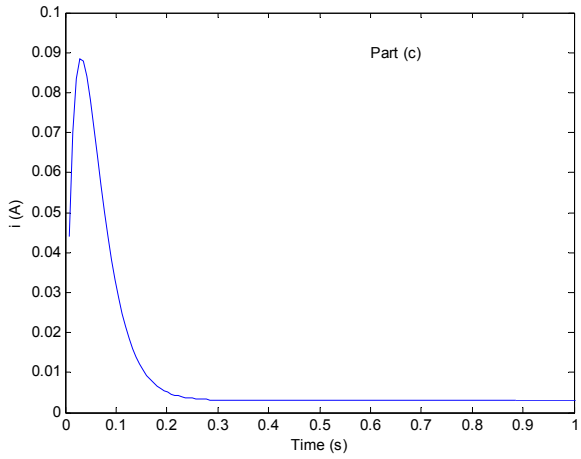
```
i =
10*C - (C*(8*L + 5*(C^2*R^2 - 4*C*L)^(1/2) - 5*C*R))/
(exp((t*((C^2*R^2 - 4*C*L)^(1/2) + C*R))/
(2*C*L))*(C^2*R^2 - 4*C*L)^(1/2)) - (C*exp((t*((C^2*R^2
- 4*C*L)^(1/2) - C*R))/(2*C*L))*(5*(C^2*R^2 -
4*C*L)^(1/2) - 8*L + 5*C*R))/(C^2*R^2 - 4*C*L)^(1/2)
isim =
```

```
10*C - (C*(8*L + 5*(C^2*R^2 - 4*C*L)^(1/2) - 5*C*R))/
(exp((t*((C^2*R^2 - 4*C*L)^(1/2) + C*R))/
(2*C*L))*(C^2*R^2 - 4*C*L)^(1/2)) - (C*exp((t*((C^2*R^2
- 4*C*L)^(1/2) - C*R))/(2*C*L))*(5*(C^2*R^2 -
4*C*L)^(1/2) - 8*L + 5*C*R))/(C^2*R^2 - 4*C*L)^(1/2)
iNb =
(1499^(1/2)*(5999/250 + (1499^(1/2)*sqrt(-1))/
250)*sqrt(-1))/(14990*exp((6250*t*(1/1250 + (1499^(1/
2)*sqrt(-1))/1250))/3)) + 1/1250 + (1499^(1/
2)*exp((6250*t*(- 1/1250 + (1499^(1/2)*sqrt(-1))/
1250))/3)*(- 5999/250 + (1499^(1/2)*sqrt(-1))/
250)*sqrt(-1))/14990
iNc =
3/250 - (27^(1/2)*(27^(1/2)/5 + 114/5))/
(900*exp((1250*t*(27^(1/2)/25 + 6/25))/9)) - (27^(1/
2)*exp((1250*t*(27^(1/2)/25 - 6/25))/9)*(27^(1/2)/5 -
114/5))/900
iNd =
3/1000 - (3609^(1/2)*(3609^(1/2)/2000 + 47397/2000))/
(1203*exp((5000*t*(3609^(1/2)/10000 + 603/10000))/9))
- (3609^(1/2)*exp((5000*t*(3609^(1/2)/10000 - 603/
10000))/9)*(3609^(1/2)/2000 - 47397/2000))/1203
>>
```

Figures:




Part (b)
i (A)
Time (s)
0
0.02
0.04
0.06
0.08
0.1
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Part (c)
i (A)
Time (s)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Problem 31

Part a:

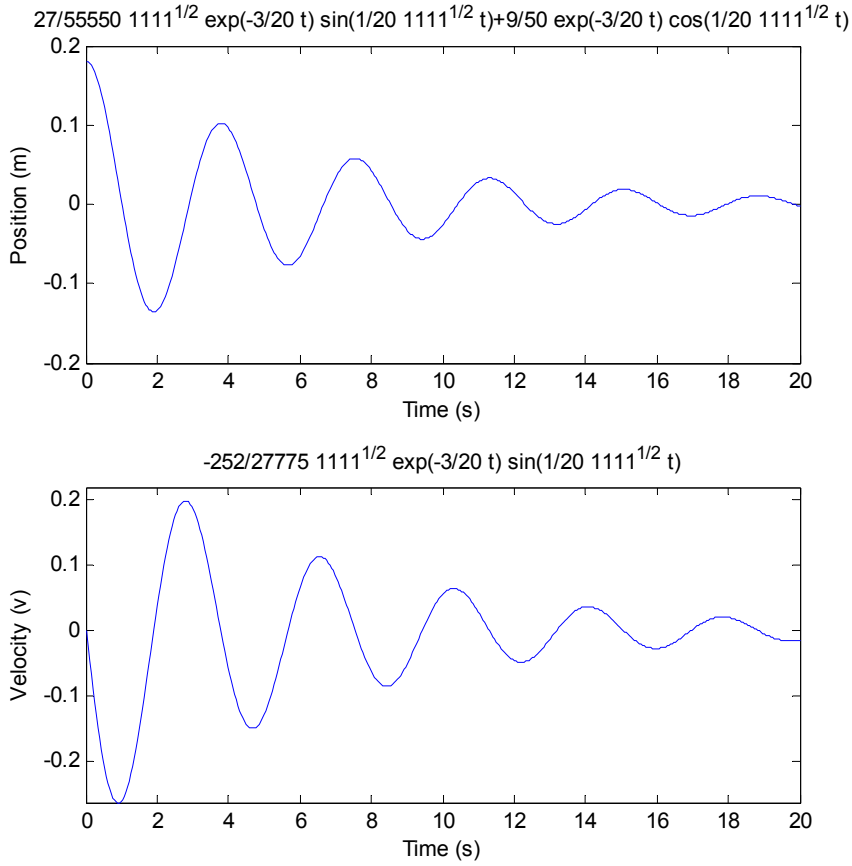
Script file:

```
clear all
syms x t
% Part a
disp('Part a:')
disp('Displacement x as a function of time:')
xs=dsolve('10*D2x+3*Dx+28*x=0','x(0)=0.18','Dx(0)=0')
%xs2=subs(xs,t,2)
subplot(2,1,1)
ezplot(xs,[0,20])
axis([0,20,-0.2,0.2])
xlabel('Time (s)')
ylabel('Position (m)')
disp('Velocity v as a function of time:')
v=diff(xs)
subplot(2,1,2)
ezplot(v,[0,20])
xlabel('Time (s)')
ylabel('Velocity (v)')
```

Command Window:

```
Part a:
Displacement x as a function of time:
xs =
27/55550*1111^(1/2)*exp(-3/20*t)*sin(1/20*1111^(1/2)*t)+9/
50*exp(-3/20*t)*cos(1/20*1111^(1/2)*t)
Velocity v as a function of time:
v =
-252/27775*1111^(1/2)*exp(-3/20*t)*sin(1/20*1111^(1/2)*t)
```

Figure:



Part b:

Script file:

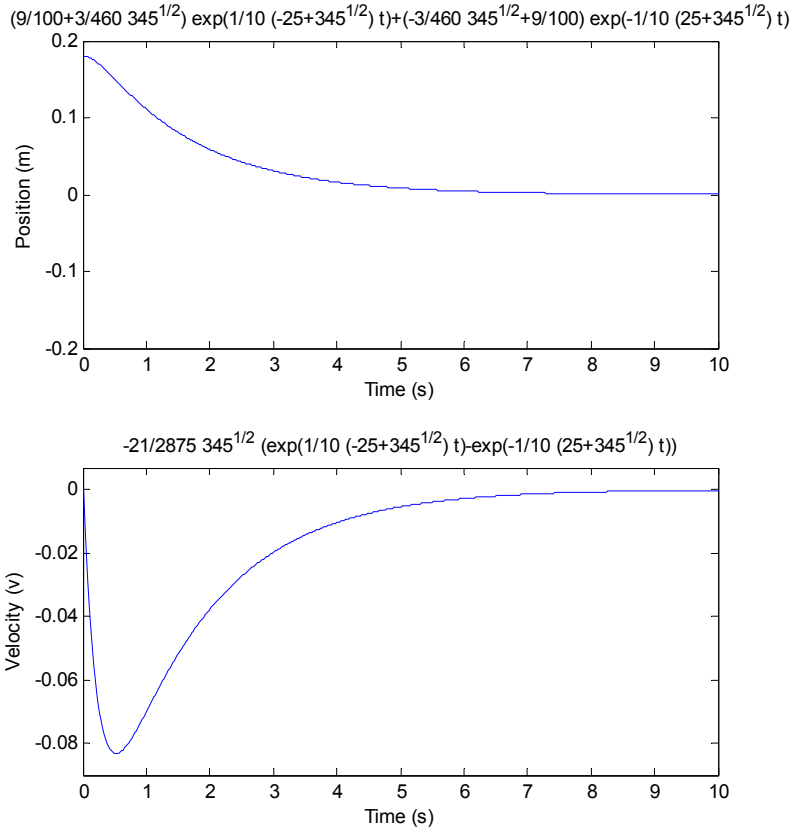
```
clear all
syms x t
disp('Part b:')
disp('Displacement x as a function of time:')
xs=sim-
ple(dsolve('10*D2x+50*Dx+28*x=0','x(0)=0.18','Dx(0)=0'))
%xs2=subs(xs,t,2)
subplot(2,1,1)
ezplot(xs,[0,10])
axis([0,10,-0.2,0.2])
xlabel('Time (s)')
```

```
ylabel('Position (m)')
disp('Velocity v as a function of time:')
v=simple(diff(xs))
subplot(2,1,2)
ezplot(v,[0,10])
xlabel('Time (s)')
ylabel('Velocity (v)')
```

Command Window:

```
Part b:
Displacement x as a function of time:
xs =
(9/100+3/460*345^(1/2))*exp(1/10*(-25+345^(1/2))*t)+(-3/
460*345^(1/2)+9/100)*exp(-1/10*(25+345^(1/2))*t)
Velocity v as a function of time:
v =
-21/2875*345^(1/2)*(exp(1/10*(-25+345^(1/2))*t)-exp(-1/
10*(25+345^(1/2))*t))
```

Figure:


(9/100+3/460 345^1/2) exp(1/10 (-25+345^1/2) t)+(-3/460 345^1/2+9/100) exp(-1/10 (25+345^1/2) t)
Position (m)
Time (s)
-21/2875 345^1/2 (exp(1/10 (-25+345^1/2) t)-exp(-1/10 (25+345^1/2) t))
Velocity (v)
Time (s)