Name: _____

Math 275 - Analytic Geometry and Calculus III

Matlab Project Sample Problems

- *(Section 13.1 # 30)* Use Matlab to graph the curve given by the vector equation

  $$\mathbf{r}(t) = \langle t^2, \ln t, t \rangle.$$

  Make sure you choose a parameter domain and viewpoints that reveal the true nature of the curve. Note: command **plot3** may be useful in plotting 3D curves.

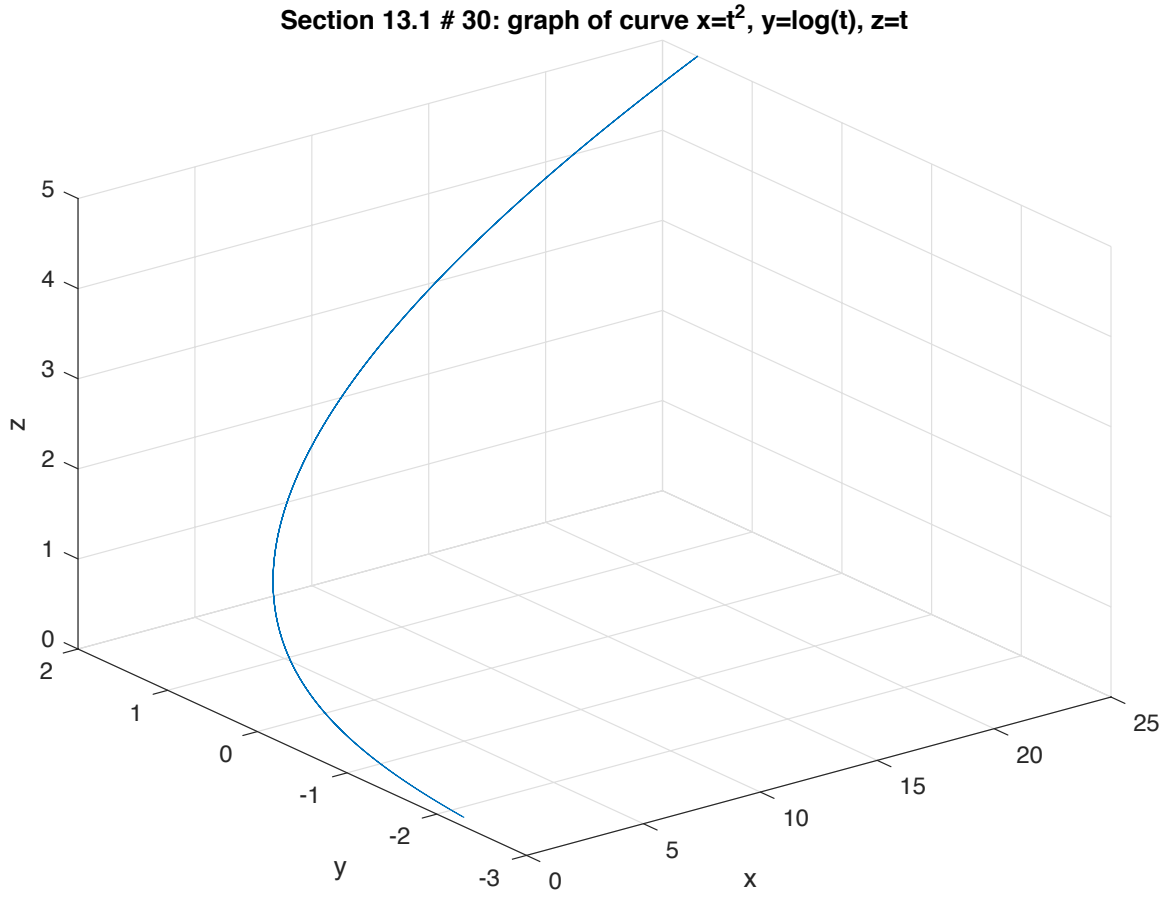

Figure 1: Section 13.1 # 30

- *(Section 13.1 # 33)* Graph the curve with parametric equations

$$x = (1 + \cos 16t)\cos t, \quad y = (1 + \cos 16t)\sin t, \quad z = 1 + \cos 16t$$

Explain the appearance of the graph by showing that it lies on a cone.

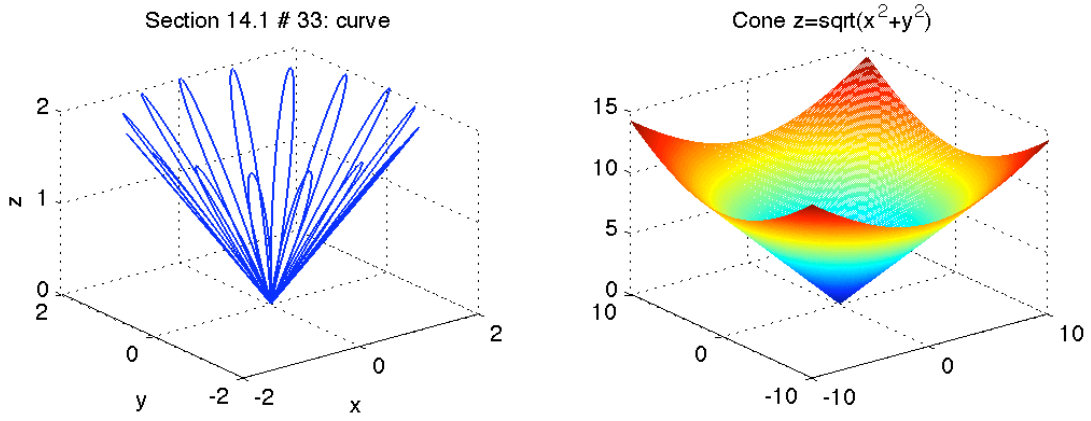

Figure 2: Section 13.1 # 33

- *(Section 13.1 # 40)* Try to sketch by hand the curve of intersection of the parabolic cylinder $y = x^2$ and the top half of the ellipsoid $x^2 + 4y^2 + 4z^2 = 16$. Then find parametric equations for this curve and use these equations and Matlab to graph the curve.

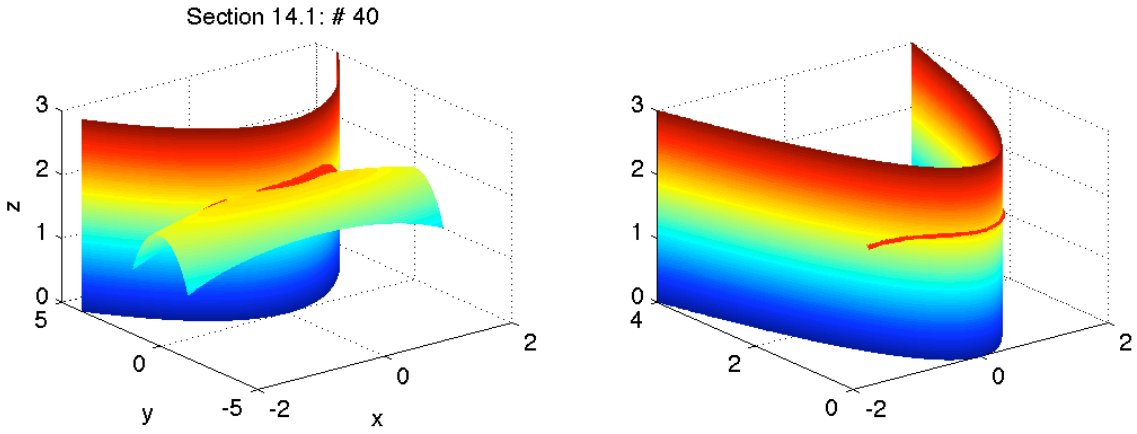

Figure 3: Section 13.1 # 40

- *(Section 13.2 # 27)* Find parametric equations for the tangent line to the curve with the parametric equations

$$x = t, \quad y = \mathrm{e}^{-t}, \quad z = 2t - t^2$$

at the point $(0, 1, 0)$. Illustrate by graphing both the curve and the tangent line on a common screen.

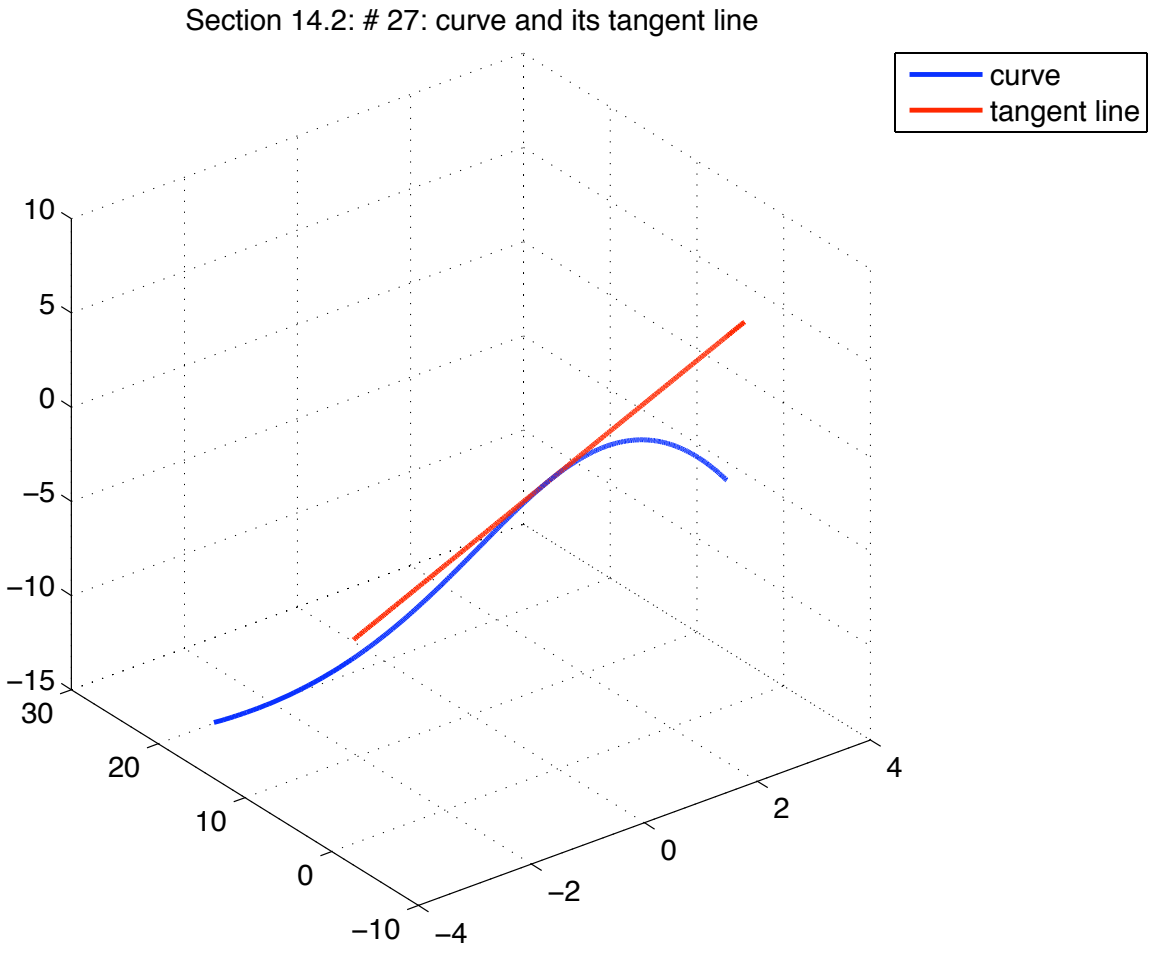

Figure 4: Section 13.2 # 27

- *(Section 13.3 # 35)* Use Matlab to graph both the curve

  $$y = x^{-2}$$

  and its curvature function $\kappa(x)$ on the same screen. Is the graph of κ what you would expect?

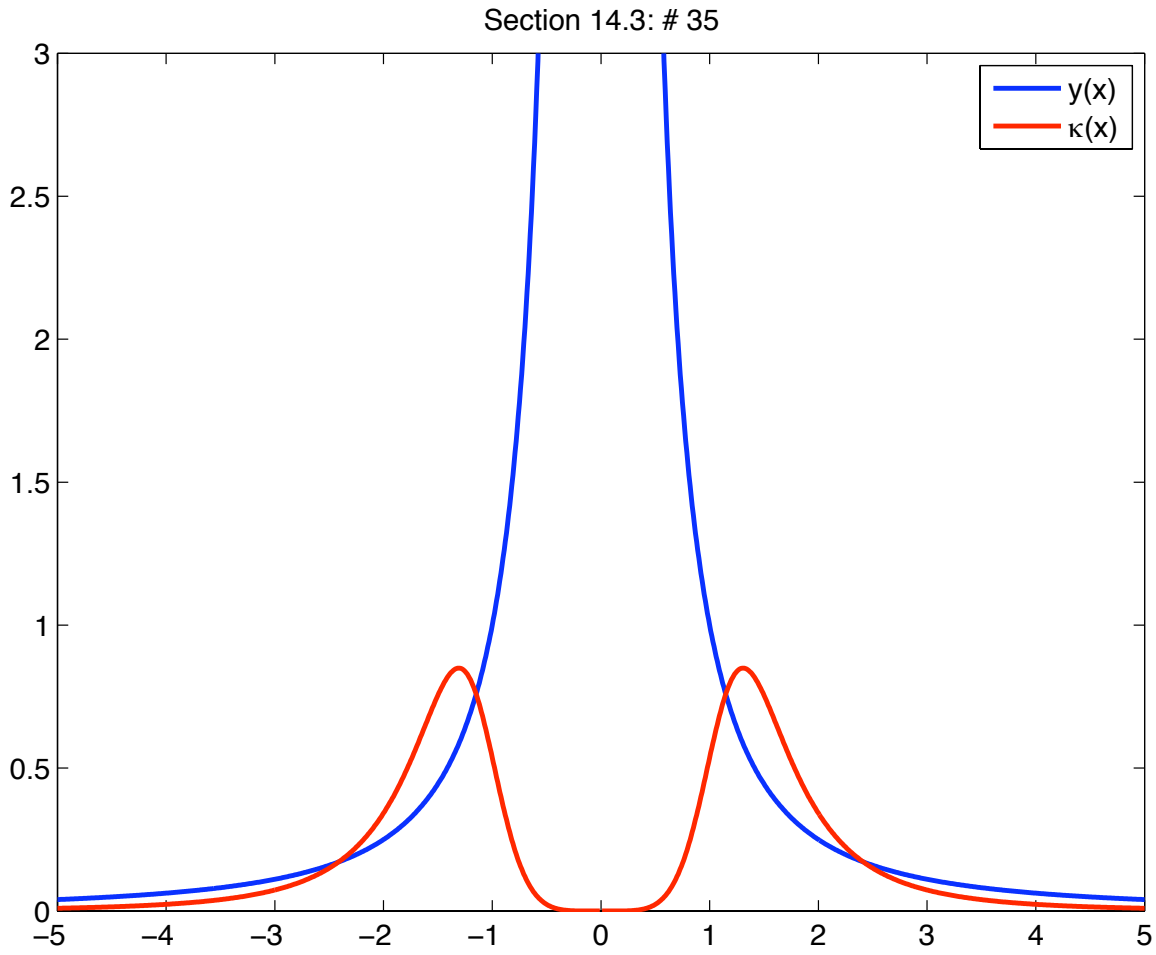

Figure 5: Section 13.3 # 35

- *(Section 14.1 # 51, # 52)* Use Matlab to graph the function using different domains and viewpoints. Get a printout of one that, in your opinion, gives a good view. Plot also some contour curves of the same function and compare with the graph.

  (a) $f(x, y) = \mathrm{e}^{-x^2} + \mathrm{e}^{-2y^2}$

  (b) $f(x, y) = (1 - 3x^2 + y^2)\,\mathrm{e}^{1-x^2-y^2}$

  Note: commands **meshgrid**, **mesh**, **surf**, **contour** may be useful in plotting surfaces and contour curves.

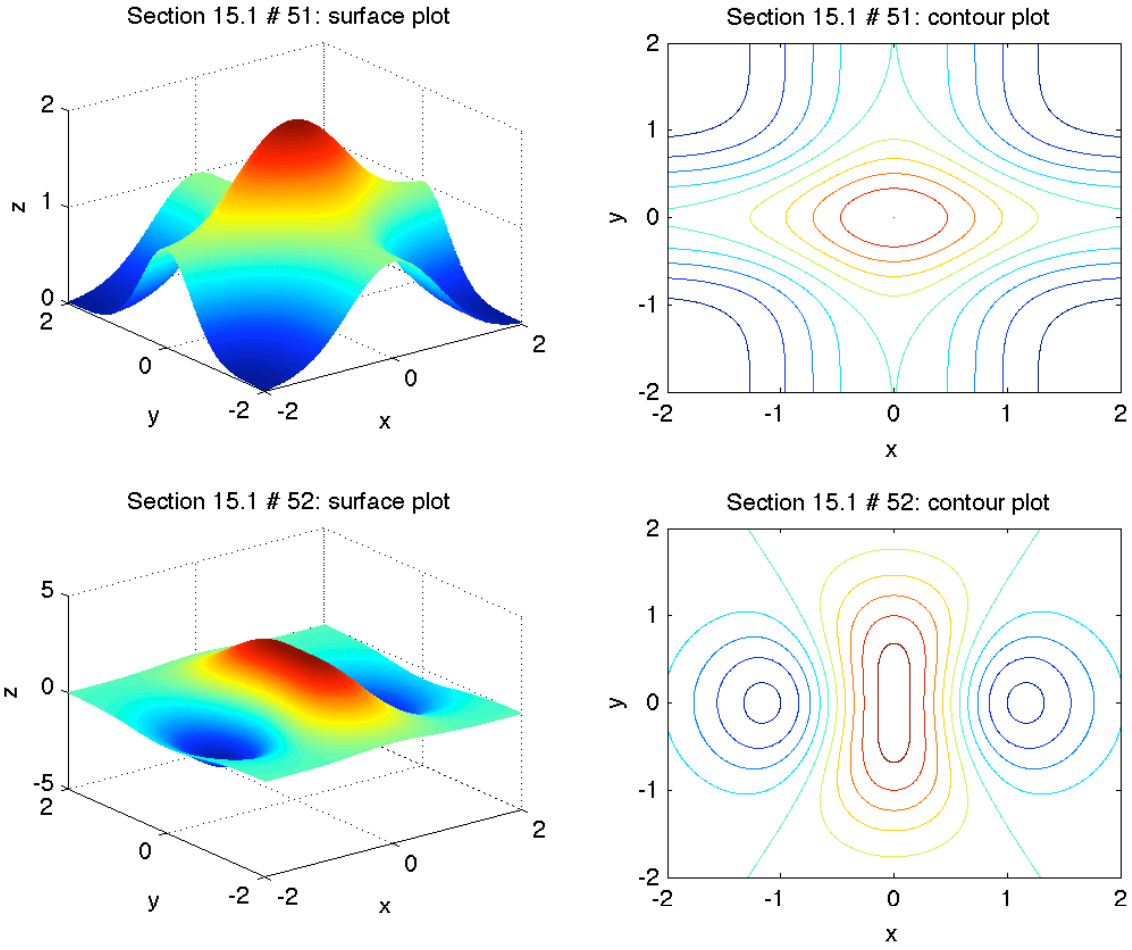

Figure 6: Section 14.1 # 51 and # 52

- *(Section 14.1 # 70)* Use Matlab to graph the function

$$f(x,y) = \frac{xy}{x^2+y^2}$$

using using different domains and viewpoints. Comment of limiting behavior of the function. What happens when both x and y become large? What happens when (x,y) approaches the origin?

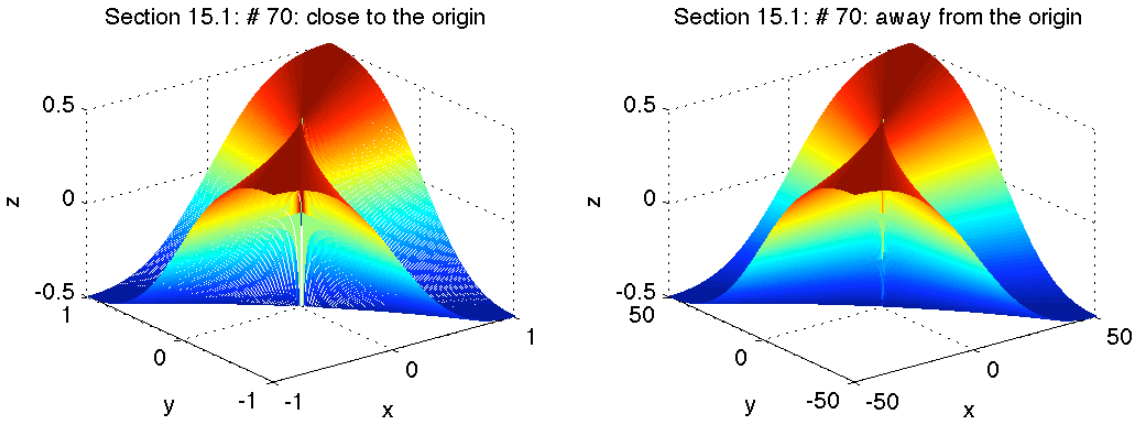

Figure 7: Section 14.1 # 70

- *(Section 14.4 # 8)* Graph the surface

$$z = \arctan(xy^2)$$

and the tangent plane at the point $(1, 1, \pi/4)$. (Choose the domain and viewpoint so that you get a good view of both the surface and the tangent plane.) Then zoom in until the surface and the tangent plane become indistinguishable.

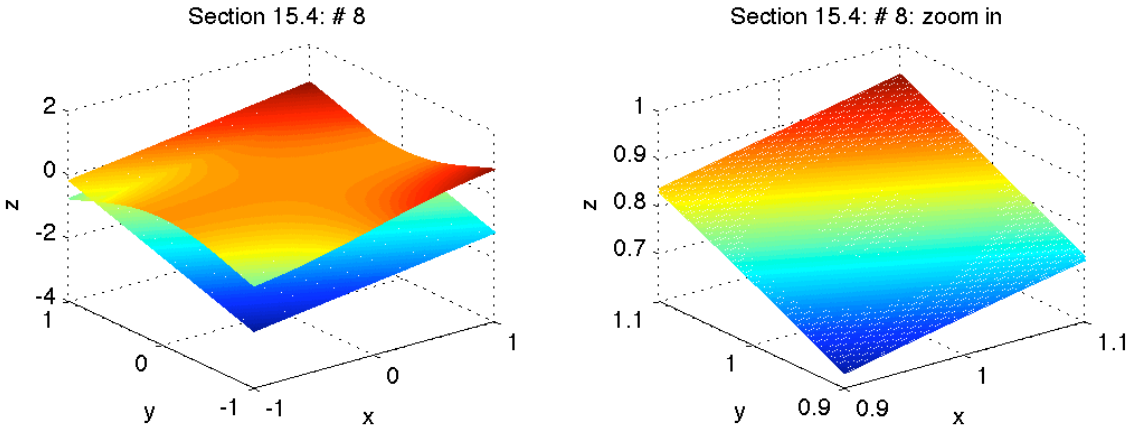

Figure 8: Section 14.4 # 8

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Math 275: This is program
% matlab_problems_examples.m to for Matlab project
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

clear all

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 13.1 # 30
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

t=0.1:1e-3:5;

x=t.^2; y=log(t); z=t;

figure(1); clf(1)
set(gca,'FontSize',12); set(gca,'box','on')

plot3(x,y,z)
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 13.1 # 30: graph of curve x=t^2, y=log(t), z=t')
grid on

print -depsc2 problem_13_1_30.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 13.1 # 33
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

t=-10:1e-3:10;

figure(2); clf(2)
set(gca,'FontSize',12); set(gca,'box','on')

x=(1+cos(16*t)).*cos(t);
y=(1+cos(16*t)).*sin(t);
z=(1+cos(16*t));

subplot(2,2,1)

plot3(x,y,z,'Linewidth',1)
xlabel('x')
```

```
ylabel('y')
zlabel('z')
title('Section 13.1 # 33: curve')
grid on

t=-10:1e-1:10;

subplot(2,2,2)
x=t; y=t;
[X,Y]=meshgrid(x,y);
f=inline('sqrt(x.^2+y.^2)','x','y');
mesh(X,Y,f(X,Y))
%xlim([-2 2])
%ylim([-2 2])
%zlim([0 2])
title('Cone z=sqrt(x^2+y^2)')

print -depsc2 problem_13_1_33.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 13.1 # 40
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure(3); clf(3)
set(gca,'FontSize',12); set(gca,'box','on')

subplot(2,2,1)
x=-2:1e-2:2;
z=0:1e-2:3;
f=inline('x.^2','x','z');
[X3,Z3]=meshgrid(x,z);
mesh(X3,f(X3,Z3),Z3)
hold on

subplot(2,2,2)
mesh(X3,f(X3,Z3),Z3)
hold on

subplot(2,2,1)

x=-2:1e-2:2;
y=-sqrt(2):1e-2:sqrt(2);
f=inline('sqrt(4-x.^2/4-y.^2)','x','y');
[X2,Y2]=meshgrid(x,y);
mesh(X2,Y2,f(X2,Y2))
```

```
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 13.1: # 40')

x=-1:1e-2:1;
y=x.^2;
z=sqrt(4-x.^4-x.^2/4);
plot3(x,y,z,'rd','Linewidth',5)

subplot(2,2,2)
plot3(x,y,z,'r','Linewidth',4)

print -depsc2 problem_13_1_40.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 13.2 # 27
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure(4); clf(4)
set(gca,'FontSize',12); set(gca,'box','on')

t=-3:1e-2:3;

x1=t; y1=exp(-t); z1=2*t-t.^2;
x2=t; y2=1-t; z2=2*t;

plot3(x1,y1,z1,'b','Linewidth',2)
hold on
plot3(x2,y2,z2,'r','Linewidth',2)
grid on

legend('curve','tangent line')
title('Section 13.2: # 27: curve and its tangent line')

print -depsc2 problem_13_2_27.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 13.3 # 35
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure(5); clf(5)
set(gca,'FontSize',12); set(gca,'box','on')
```

```
x=-5:1e-2:5;
y=x.^(-2);
kappa=6*x.^(-4)./((1+4*x.^(-6)).^(3/2));

plot(x,y,'b','Linewidth',2)
hold on
plot(x,kappa,'r','Linewidth',2)
ylim([0 3])
legend('y(x)','\kappa(x)')
title('Section 13.3: # 35')

print -depsc2 problem_13_3_35.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 14.1 # 51, 52
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure(6); clf(6)
set(gca,'FontSize',12); set(gca,'box','on')

x=-2:1e-2:2;
y=x;
[X,Y]=meshgrid(x,y);
f=inline('exp(-x.^2)+exp(-2*y.^2)','x','y');
g=inline('(1-3*x.^2+y.^2).*exp(1-x.^2-y.^2)','x','y');

subplot(2,2,1)
mesh(X,Y,f(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.1 # 51: surface plot')

subplot(2,2,2)
contour(X,Y,f(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.1 # 51: contour plot')

subplot(2,2,3)
mesh(X,Y,g(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
```

```
title('Section 14.1 # 52: surface plot')

subplot(2,2,4)
contour(X,Y,g(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.1 # 52: contour plot')

print -depsc2 problem_14_1_51_52.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 15.1 # 70
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure(7); clf(7)
set(gca,'FontSize',12); set(gca,'box','on')

x=-1:1e-2:1;
y=x;
[X,Y]=meshgrid(x,y);
f=inline('(x.*y)./(x.^2+y.^2)','x','y');

subplot(2,2,1)
mesh(X,Y,f(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.1: # 70: close to the origin')

subplot(2,2,2)
x=-50:1e-1:50;
y=x;
[X,Y]=meshgrid(x,y);
mesh(X,Y,f(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.1: # 70: away from the origin')

print -depsc2 problem_14_1_70.eps

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%   Section 14.4 # 8
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
figure(8); clf(8)
set(gca,'FontSize',12); set(gca,'box','on')

x=-1:1e-2:1;
y=x;
[X,Y]=meshgrid(x,y);
f=inline('atan(x.*y.^2)','x','y');      % surface

subplot(2,2,1)
mesh(X,Y,f(X,Y))
hold on
g=inline('pi/4+(x-1)/2+y-1','x','y');   % tangent plane
mesh(X,Y,g(X,Y))
xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.4: # 8')

x2=0.9:1e-3:1.1;
y2=x2;
[X2,Y2]=meshgrid(x2,y2);

subplot(2,2,2)
mesh(X2,Y2,f(X2,Y2))
hold on
mesh(X2,Y2,g(X2,Y2))

xlabel('x')
ylabel('y')
zlabel('z')
title('Section 14.4: # 8: zoom in')
xlim([0.9 1.1])
ylim([0.9 1.1])

print -depsc2 problem_14_4_8.eps
```