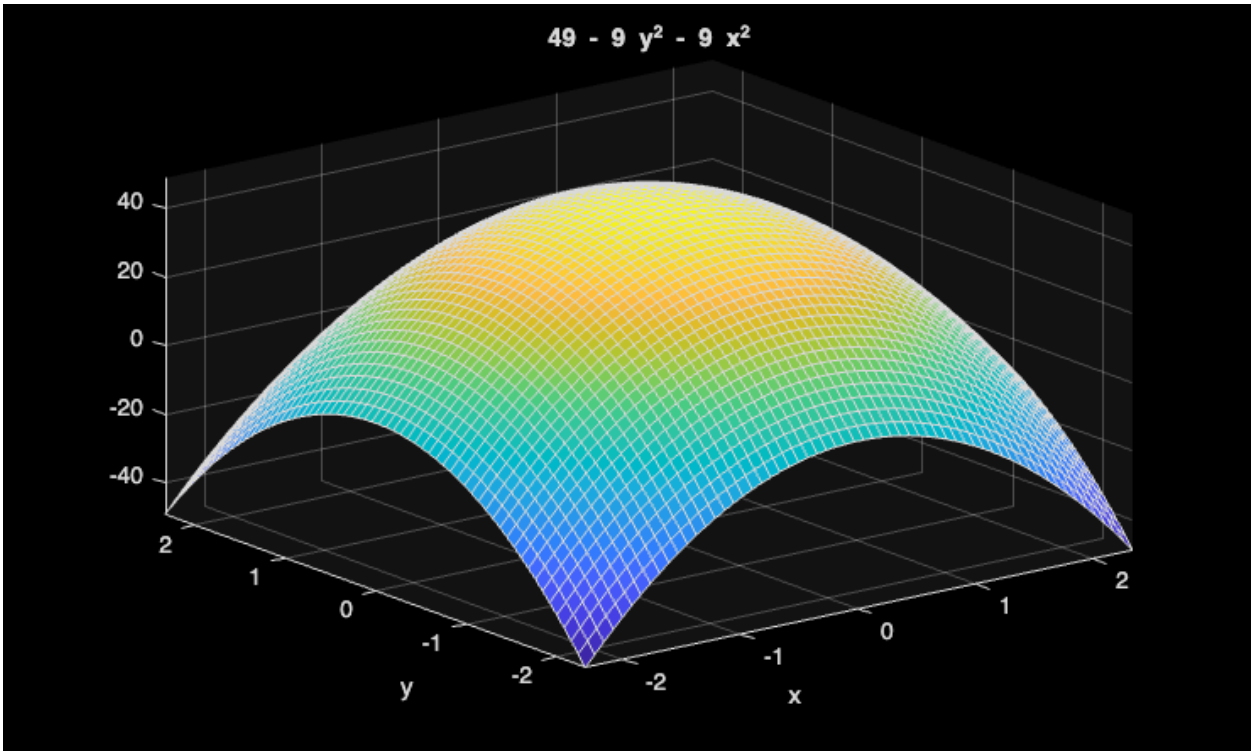
```
clc; clear; close all

% Problem 1:

% (a)
n1 = [5 7 -5]; n2 = [3 4 -6];
dot_a = dot(n1,n2)
cross_a = cross(n1,n2)

% (b)
n1 = [1 4 -21]; n2 = [-3 -12 63];
dot_b = dot(n1,n2)
cross_b = cross(n1,n2)

% (c)
n1 = [7 28 -49]; n2 = [-1 2 1];
dot_c = dot(n1,n2)
cross_c = cross(n1,n2)

% Problem 2:

syms x y
z = 7*y^3*exp(3*x*y^2 + x^3*y);

zx = simplify(diff(z, x))
zy = simplify(diff(z, y))
zyyx = simplify(diff(diff(z, y, 2), x))
zxxy = simplify(diff(diff(z, x, 2), y))
zyyxyx = simplify(diff(diff(diff(diff(diff(diff(z, y, 2), x), y), x), y), x))

% Problem 3:

syms x y z l

f = x*y + 2*x*z + 2*y*z;
g = x*y*z - 4000*7^3;
L = f - l*g;


S = solve(diff(L,x), diff(L,y), diff(L,z), g)


S.x(1)
S.y(1)
S.z(1)

f_val = subs(f, [x y z], [S.x(1) S.y(1) S.z(1)])


% Problem 4:

% (a) Paraboloid
```

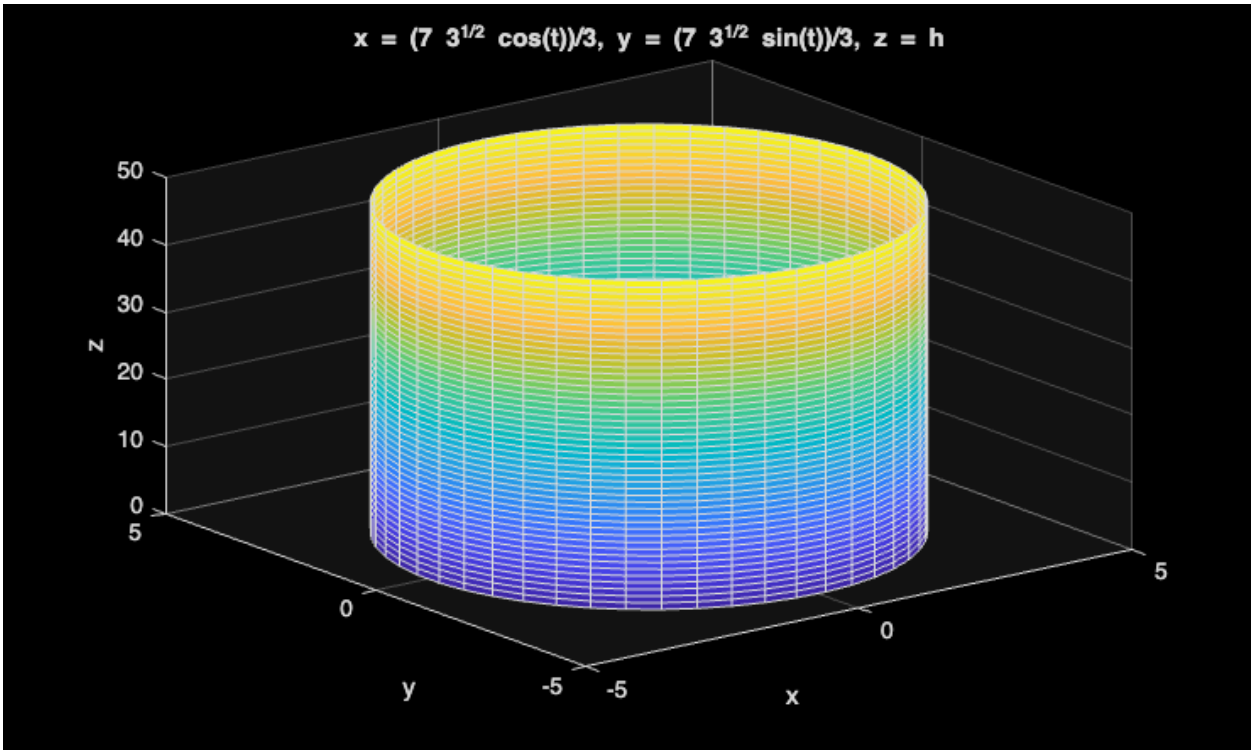
```
syms x y
ezsurf(49 - 9*x^2 - 9*y^2, [-7/3 7/3 -7/3 7/3])

figure

% (b) Cylinder
syms t h
r = 7/sqrt(3);
ezsurf(r*cos(t), r*sin(t), h, [0 49 0 2*pi])

figure

% (c) Intersection curve
syms t
r = 7/sqrt(3);
ezplot3(r*cos(t), r*sin(t), -98, [0 2*pi])
axis equal

% Problem 5:

% compute volume symbolic
syms r th
V = int(int((2*7 - r)*r, r, 0, 7), th, 0, 2*pi);
simplify(V)
vpa(V,6)

% plot cone and cylinder boundary (minimal)
syms r t h
hold on
ezsurf(r*cos(t), r*sin(t), 2*7 - r, [0 7 0 2*pi])    % cone (0<=r<=7)
ezsurf(7*cos(t), 7*sin(t), h, [0 7 0 2*pi])          % cylinder (0<=h<=7)
hold off
axis equal
```

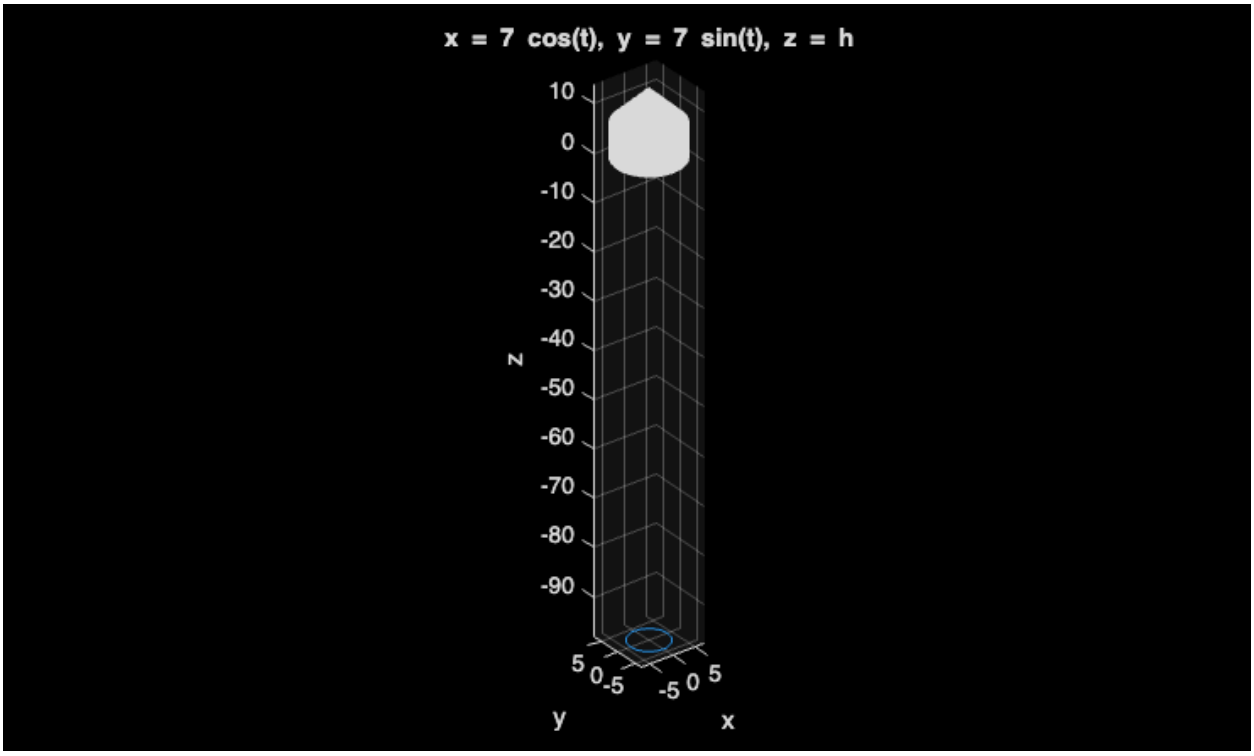
```
dot_a =

    73


cross_a =

   -22    15    -1


dot_b =

       -1374


cross_b =

     0     0     0
```

```
dot_c =

     0


cross_c =

   126    42    42


zx =

21*y^4*exp(x*y*(x^2 + 3*y))*(x^2 + y)


zy =

7*y^2*exp(x*y*(x^2 + 3*y))*(x^3*y + 6*x*y^2 + 3)


zyyx =

21*y^2*exp(x*y*(x^2 + 3*y))*(x^8*y^2 + 13*x^6*y^3 + 8*x^5*y + 48*x^4*y^4 +
64*x^3*y^2 + 36*x^2*y^5 + 12*x^2 + 66*x*y^3 + 20*y)


zxxy =

21*y^3*exp(x*y*(x^2 + 3*y))*(3*x^7*y^2 + 24*x^5*y^3 + 17*x^4*y + 39*x^3*y^4 +
48*x^2*y^2 + 18*x*y^5 + 8*x + 21*y^3)


zyyxyx =

21*exp(x*y*(x^2 + 3*y))*(9*x^18*y^6 + 243*x^16*y^7 + 234*x^15*y^5 +
2619*x^14*y^8 + 5418*x^13*y^6 + 14265*x^12*y^9 + 1982*x^12*y^4 +
46980*x^11*y^7 + 41040*x^10*y^10 + 37740*x^10*y^5 + 187920*x^9*y^8
+ 6512*x^9*y^3 + 60264*x^8*y^11 + 242460*x^8*y^6 + 348300*x^7*y^9
+ 94608*x^7*y^4 + 42768*x^6*y^12 + 615060*x^6*y^7 + 7704*x^6*y^2 +
283824*x^5*y^10 + 382752*x^5*y^5 + 11664*x^4*y^13 + 594540*x^4*y^8 +
72504*x^4*y^3 + 81648*x^3*y^11 + 465048*x^3*y^6 + 2352*x^3*y + 175932*x^2*y^9
+ 125496*x^2*y^4 + 132192*x*y^7 + 8496*x*y^2 + 27216*y^5 + 48)


S =

  struct with fields:

    l: [3×1 sym]
    x: [3×1 sym]
    y: [3×1 sym]
    z: [3×1 sym]
```

```
ans =

140

ans =

140

ans =

70

f_val =

58800

ans =

(1372*pi)/3

ans =

1436.76
```


49 - 9 y² - 9 x²
40
20
0
-20
-40
2
1
0
-1
-2
y
-2
-1
0
1
2
x


x = (7 3^1/2 cos(t))/3, y = (7 3^1/2 sin(t))/3, z = h
50
40
30
20
10
0
z
5
0
-5
y
-5
0
5
x




*Published with MATLAB® R2025b*