Exercises 4.1

1. Find the Jacobian determinants for the transformation from Cartesian coordinates to polar coordinates

```
clear all
clc
```

```
syms x y r theta phi rho

x = r * cos(theta);
y = r * sin(theta);

jacobian1 = [diff(x, r) diff(x, theta)
             diff(y, r) diff(y, theta)];

J1 = simplify(det(jacobian1))
```

J1 = r

```
clear x y

x = rho * sin(phi) * cos(theta);
y = rho * sin(phi) * sin(theta);
z = rho * cos(phi);

jacobian2 = [diff(x, rho) diff(x, theta) diff(x, phi)
              diff(y, rho) diff(y, theta) diff(y, phi)
              diff(z, rho) diff(z, theta) diff(z, phi)];

J2 = simplify(det(jacobian2))
```

J2 = $-\rho^2 \sin(\phi)$