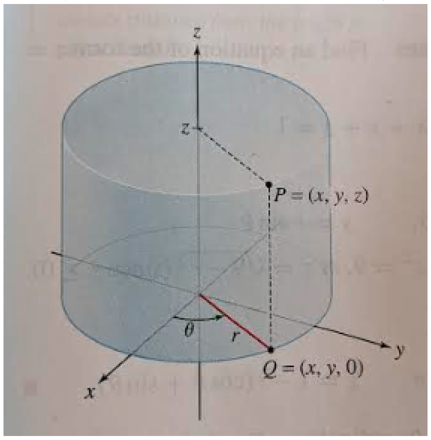
Cylindrical Coordinates (r, θ, z)



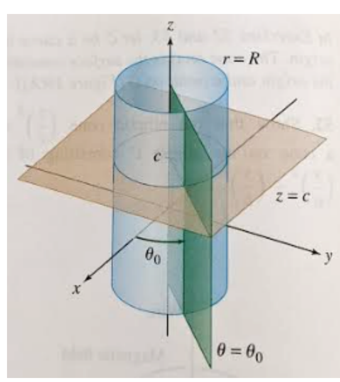
Cylindrical to Rectangular	Rectangular to Cylindrical

1. Find the rectangular coordinates of the point P with cylindrical coordinates $(r, \theta, z) = (2, \frac{3\pi}{4}, 5)$

2. Find cylindrical coordinates for the point with rectangular coordinates $(x, y, z) = (-3\sqrt{3}, -3, 5)$

Level Surfaces: are the surfaces obtained by setting one of the coordinates equal to a constant

In rectangular coordinates: In cylindrical coordinates:



3. Find an equation of the form $z = f(r, \theta)$ for the surfaces:
    a. $x^2 + y^2 + z^2 = 9$, with $z \geq 0$

    b. $x + y + z = 1$

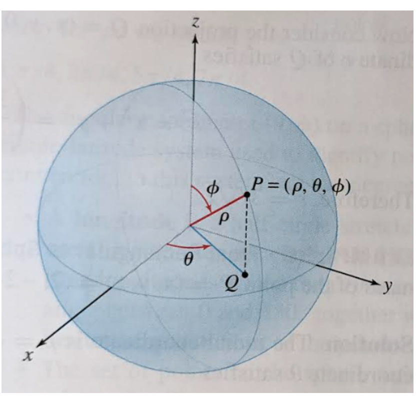
4. Graph the surface corresponding to the equation in cylindrical coordinates given by $z = r^2$

Spherical Coordinates (p, θ, ϕ)

can define a point P using two angles → θ and ϕ

θ defines the angle on the xy-plane

ϕ defines the angle of declination → the angle between the z-axis and the ray through point P



Restrict $p \geq 0$ and $0 \leq \phi \leq \pi$

Spherical to Rectangular	Rectangular to Spherical
	$p =$
	$\tan \theta =$
	$\cos \phi =$

Find $r =$ therefore:

$x = r \cos \theta =$ $y = r \sin \theta =$ $z =$

5. Find the rectangular coordinates of $P = (p, \theta, \phi) = (3, \frac{\pi}{3}, \frac{\pi}{4})$, and find the radial coordinate r of its projection Q onto the xy −plane.

6. Find the spherical coordinates of the point $P = (x, y, z) = (2, -\ 2\sqrt{3}, 3)$

7. Find an equation of the form $p = f(\theta, \phi)$ for the following surfaces:
   a. $x^2 + y^2 + z^2 = 9$

   b. $z = x^2 - y^2$

8. Graph $p = \sec \theta$