Exercise 11

Let S be the sphere of radius R centered at the origin. Find the equation for S in cylindrical coordinates.

Solution

The equation for a sphere is given by

$$x^2 + y^2 + z^2 = R^2.$$

Substitute $x = r\cos\theta$, $y = r\sin\theta$, and $z = z$ to get the equation in cylindrical coordinates.

$$(r\cos\theta)^2 + (r\sin\theta)^2 + z^2 = R^2$$

$$r^2\cos^2\theta + r^2\sin^2\theta + z^2 = R^2$$

$$r^2(\cos^2\theta + \sin^2\theta) + z^2 = R^2$$

$$r^2 + z^2 = R^2$$