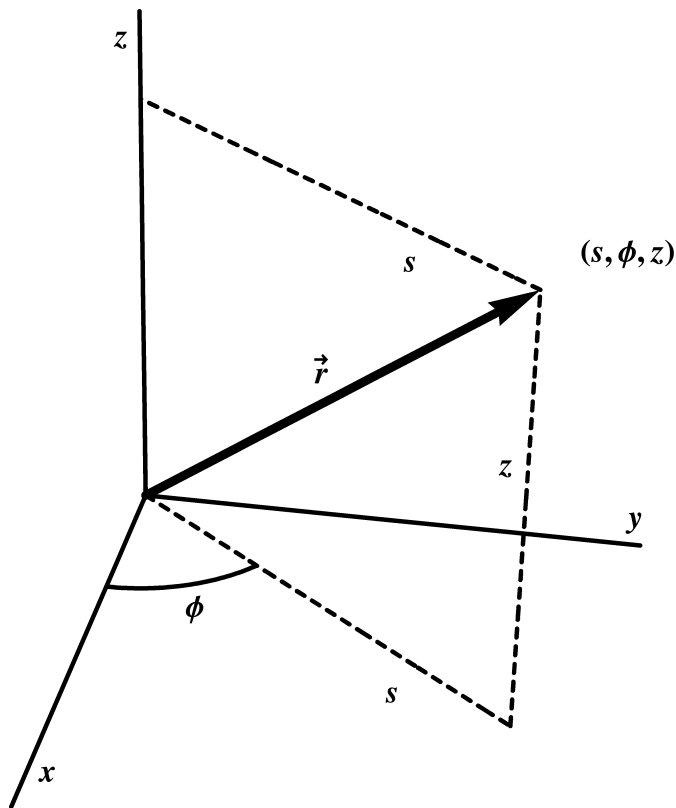


1 Cylindrical Coordinates

For the cylindrical coordinate system shown below, draw three surfaces: one for constant s , one for constant ϕ , and one for constant z .



$$x = s \cos \phi \quad (1)$$

$$y = s \sin \phi \quad (2)$$

$$z = z \quad (3)$$

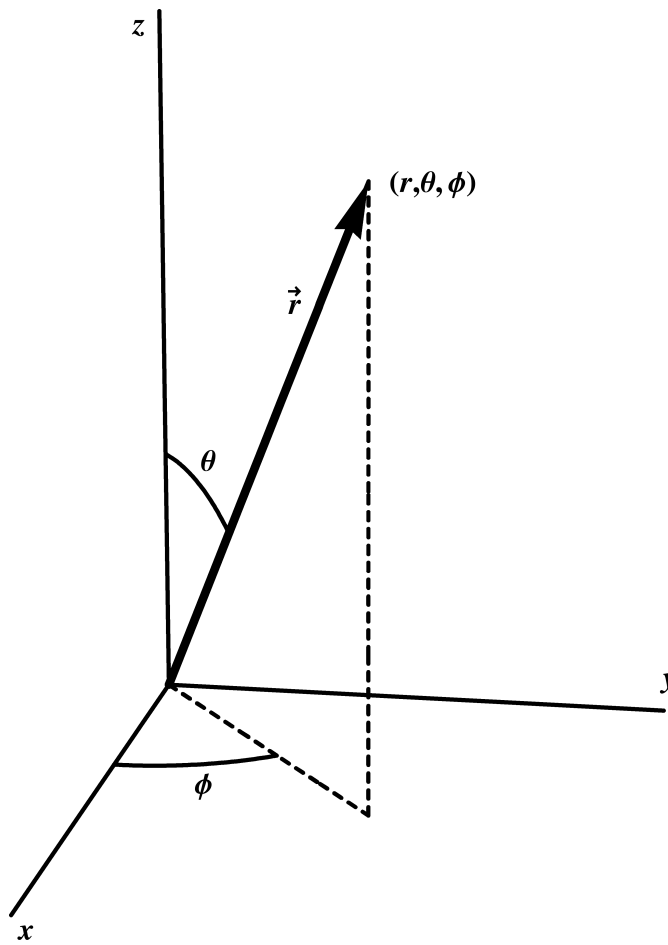
$$0 \leq s < \infty \quad (4)$$

$$0 \leq \phi < 2\pi \quad (5)$$

$$-\infty < z < \infty \quad (6)$$

2 Spherical Coordinates

For the spherical coordinate system shown below, draw three surfaces: one for constant r , one for constant θ , and one for constant ϕ .



$$x = r \sin \theta \cos \phi \quad (7)$$

$$y = r \sin \theta \sin \phi \quad (8)$$

$$z = r \cos \theta \quad (9)$$

$$0 \leq r < \infty \quad (10)$$

$$0 \leq \theta < \pi \quad (11)$$

$$0 \leq \phi < 2\pi \quad (12)$$

$$(13)$$