



Polar coordinates (θ, r)

Cylindrical coordinates (θ, r, z)

$$x = r \cos \theta$$

$$dA = \mathbf{r} \, d\theta \, dr$$

$$y = r \sin \theta$$

$$dV = \mathbf{r} \, d\theta \, dr \, dz$$

$$z = z$$

$$r = \text{distance from } z\text{-axis} = \sqrt{x^2 + y^2}$$

Spherical coordinates (θ, ρ, ϕ)

$$x = \overbrace{\rho \sin \phi}^r \cos \theta$$

$$y = \rho \sin \phi \sin \theta$$

$$dV = \boldsymbol{\rho}^2 \sin \phi \, d\theta \, d\rho \, d\phi$$

$$z = \rho \cos \phi$$

$$\rho = \text{distance from origin} = \sqrt{x^2 + y^2 + z^2}$$

$$\phi = \text{angle with } z\text{-axis}$$