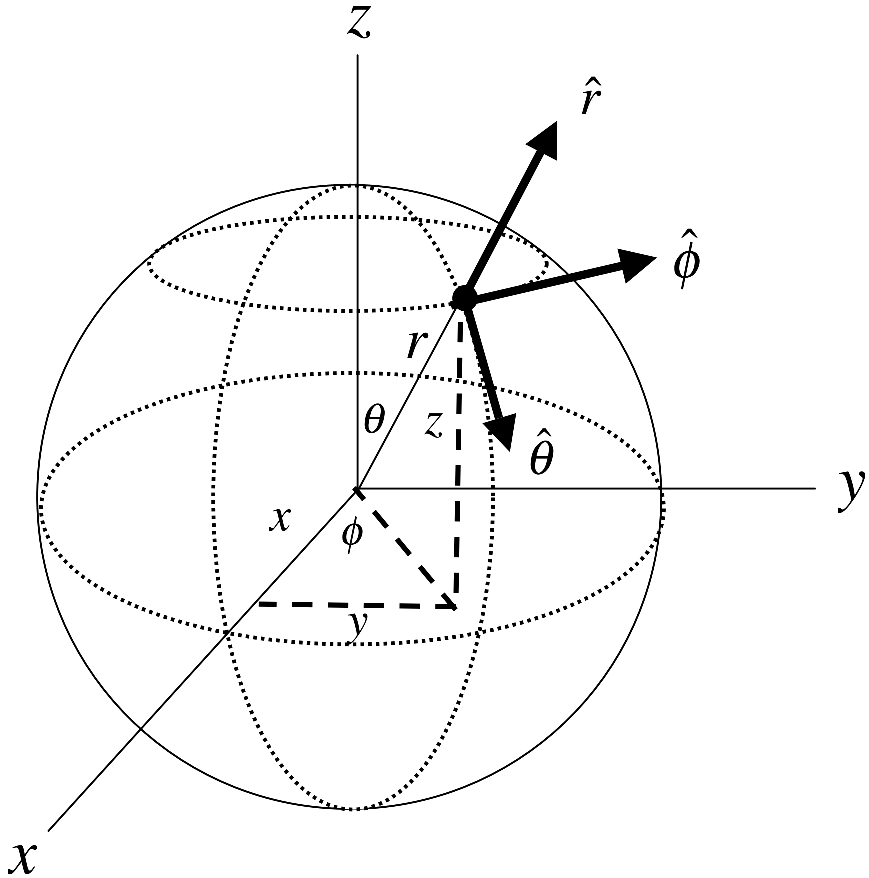
Spherical Coordinate System (r, θ, ϕ)



$x = r\,\sin\theta\,\cos\phi$ $\qquad$ $\hat{x} = \sin\theta\,\cos\phi\;\hat{r} + \cos\theta\,\cos\phi\;\hat{\theta} - \sin\phi\,\hat{\phi}$

$y = r\,\sin\theta\,\sin\phi$ $\qquad$ $\hat{y} = \sin\theta\,\sin\phi\;\hat{r} + \cos\theta\,\sin\phi\;\hat{\theta} + \cos\phi\,\hat{\phi}$

$z = r\,\cos\theta$ $\qquad$ $\hat{z} = \cos\theta\;\hat{r} - \sin\theta\;\hat{\theta}$

Line element: $d\mathbf{l} = dr\,\hat{r} + rd\theta\;\hat{\theta} + r\sin\theta\,d\phi\;\hat{\phi}$

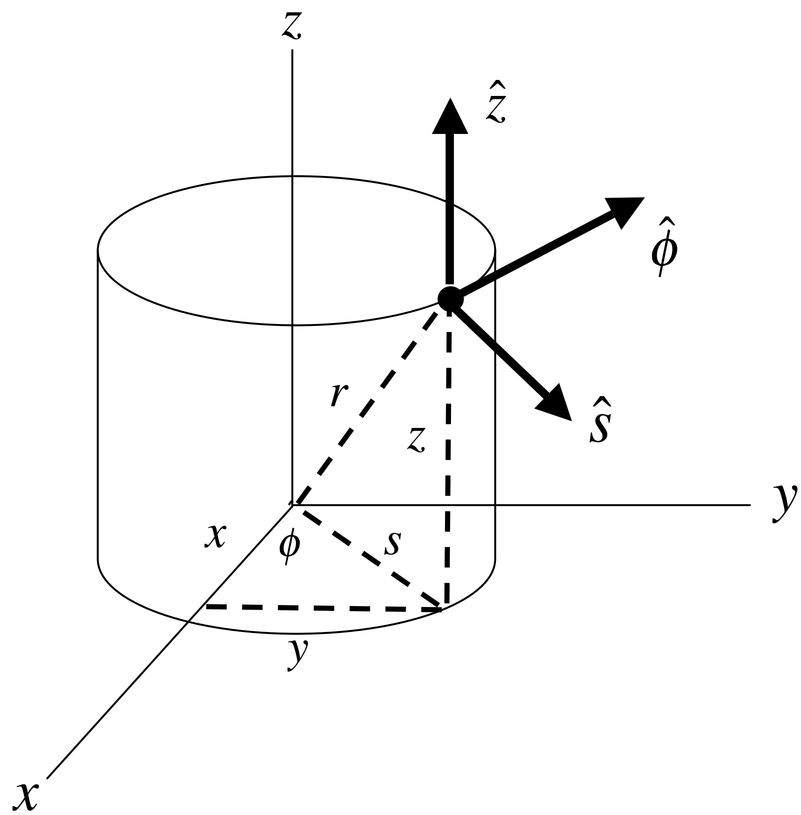
Volume element: $d\tau = r^2\sin\theta\;d\theta\,d\phi\;dr$

Area element on surface of sphere (r=constant): $da = r^2\sin\theta\;d\theta\,d\phi = r^2 d\Omega$

Solid angle element: $d\Omega = \sin\theta\;d\theta\,d\phi$

Note: The definitions for θ and ϕ used here are those used in physics and engineering. A common convention in math textbooks has these definitions of θ and ϕ interchanged. (See http://mathworld.wolfram.com/SphericalCoordinates.html for the prototype figure based on the common math convention for θ and ϕ.)

Cylindrical Coordinate System (s, ϕ, z)



$x = s\cos\phi$ $\qquad$ $\hat{x} = \cos\phi\,\hat{s} - \sin\phi\,\hat{\phi}$

$y = s\sin\phi$ $\qquad$ $\hat{y} = \sin\phi\,\hat{s} + \cos\phi\,\hat{\phi}$

Line element: $d\mathbf{l} = ds\,\hat{s} + s\,d\phi\,\hat{\phi} + dz\,\hat{z}$

Volume element: $d\tau = s\,d\phi\,ds\,dz$

Area element on cylindrical surface (s= constant): $da = s\,d\phi\,dz$

Area element on circular-disk surface (z= constant): $da = s\,d\phi\,ds$

Note: The choice of the symbol s for the radial coordinate, as used here and in Griffiths' textbook, is not the most common one. The symbols ρ or r are more commonly used in place of s. (Since the symbols ρ and r are used for other quantities in the Griffiths textbook, Griffiths uses s to avoid confusion.)