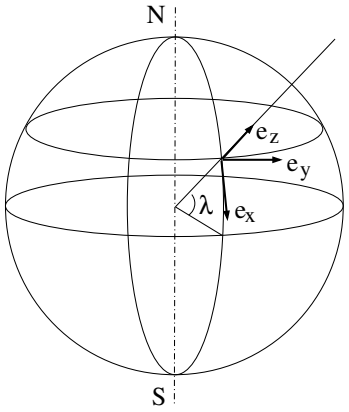
[mex63] Effects of Coriolis and centrifugal forces on falling object

Consider a location at northern latitude λ on the Earth's surface. A particle of mass m starts falling from rest at position $\mathbf{r}_0 = (0, 0, h)$ in the local coordinate system with axes as shown in the figure. (a) Determine the position $\mathbf{r}(t) = (x(t), y(t), z(t))$ during the fall. Perform the calculation to second order order in ω using the first-order results of [mex61]. (b) Find the horizontal deflections d_x, d_y from the vertical line of the point where the particle strikes the ground. Express the result as a function of λ (angle of latitude), ω (angular frequency of Earth's rotation), g (acceleration due to gravity), and h (height). (c) What are the values of d_x, d_y if $h = 100\text{m}$, $g = 9.8\text{m/s}^2$ and $\lambda = 45°$?



Solution: