Consider the solid region $R$ above the plane $z = 0$, inside the cylinder $x^2 + y^2 = 4$, and below the paraboloid $z = 7 - x^2 - y^2$. Assume that the density at point $P = (x, y, z)$ is numerically equal to the distance from $P$ to the origin. SET UP but do not evaluate a triple integral in rectangular coordinates, which represents the moment of inertia of $R$ about a line parallel to the $z$-axis and passing through the edge of the solid.

$$R: \begin{cases} -2 \leq x \leq 2 \\ -\sqrt{4-x^2} \leq y \leq \sqrt{4-x^2} \\ 0 \leq z \leq 7 - x^2 - y^2 \end{cases}$$

The density at $P$ is $\delta(x, y, z) = \sqrt{x^2 + y^2 + z^2}$; distance from $P$ to line $L$ is

$$\text{distance} = \sqrt{(x-0)^2 + (y-z)^2 + (z-z)^2} = \sqrt{x^2 + (y-z)^2}$$

Then

$$M. \text{of I. } = \int_{-2}^{2} \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_{0}^{7-x^2-y^2} \delta(x, y, z) \cdot \sqrt{x^2 + y^2 + z^2} \, dz \, dy \, dx$$