Answer on Question #37962, Physics, Mechanics | Kinematics | Dynamics

Let index one corresponds to sphere, and index two to cylinder. Hence, one has set of parameters R_1, m, ρ for sphere and R_2, h, m, ρ for cylinder (R is radius, h is the height of cylinder, m and ρ are mass and density respectively).

Mass and density of cylinder are equal. Hence, $m=\frac{4}{3}\pi\rho R_1^3=h\pi R_2^2\rho$, which yields $R_2^2=\frac{4R_1^3}{3h}$.

The moment of inertial of solid ball is $J_1=\frac{2}{5}mR_1^2$ and of cylinder $J_2=\frac{1}{2}mR_2^2$. Hence,

$$\frac{J_1}{J_2}=\frac{4R_1^2}{5R_2^2}=\frac{3h}{5R_1}.$$

Thus, which moment of inertia is higher depends on proportions of height of cylinder and radius of spherical ball (if their masses are equal):

$$J_1>J_2\Rightarrow h>\frac{5R_1}{3}$$

$$J_1<J_2\Rightarrow h<\frac{5R_1}{3}.$$