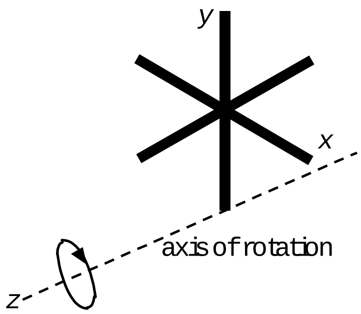
Notes on problem 10.23



The parallel axis theorem can be used for calculating the contributions of all three rods to the total I.

For the rod parallel to z, all of the mass is located at the same, or nearly the same distance, L/2, from the rotation axis. I_{CM} for rotation around the long axis is $I_{CM} = \frac{1}{2}Mr^2$, therefore, $I = I_{CM} + M\left(\frac{L}{2}\right)^2 \cong \frac{1}{4}ML^2$ from the parallel axis theorem. (the $\cong$ symbol because r << L).

For a rod rotating about an axis perpendicular to its long axis, $I_{CM} = \frac{1}{12}ML^2$

Therefore for the x and the y rods, $I = I_M + M\left(\frac{L}{2}\right)^2 = \frac{1}{3}ML^2$ from the parallel axis theorem.

The total I is the sum of these three contributions: $I_{total} \cong \frac{11}{12}ML^2$. The error is just the $I_{CM} = \frac{1}{2}Mr^2$ from the z rod. And for r << L this error is negligible.