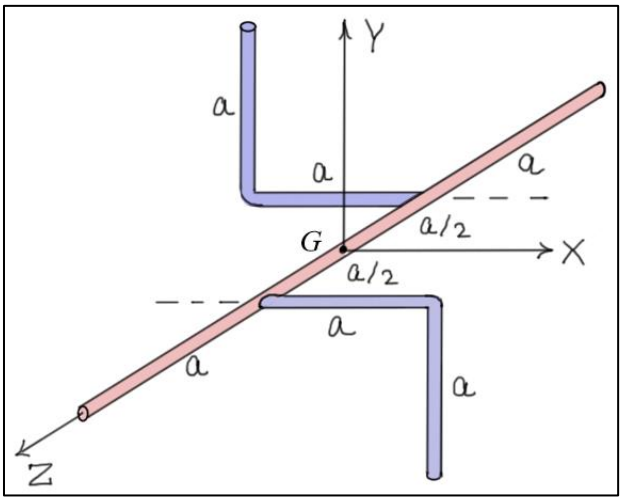
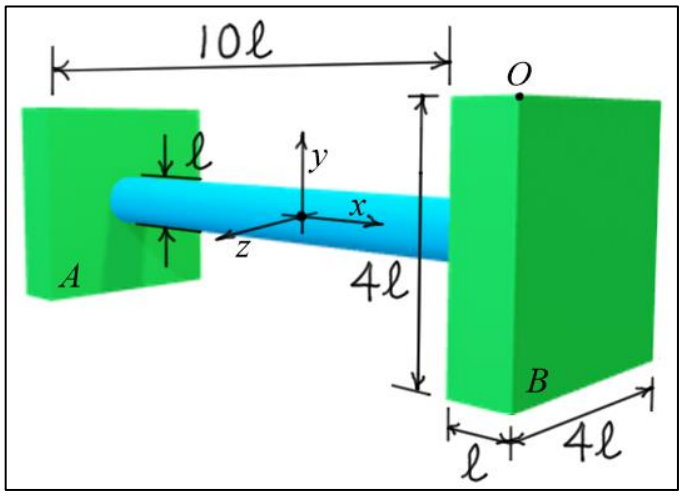
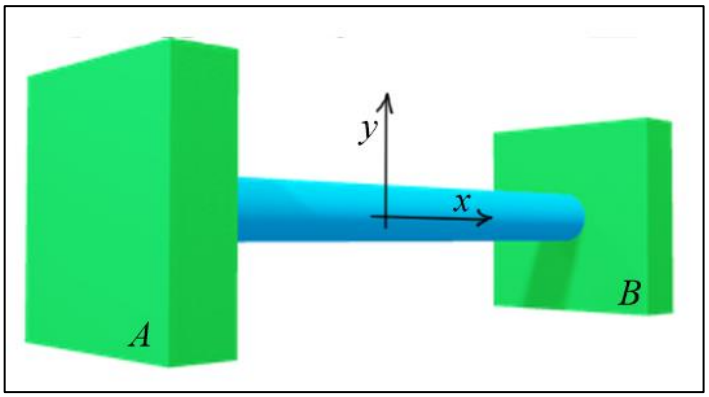
Multibody Dynamics
Exercises #5

1. The body shown consists of two L-shaped arms welded to a straight rod. The straight segment has length $3a$, and each segment of the L-shaped arms has length a. Each segment of length a has mass m. All segments are slender.
   a) Find the ***principal moments*** of ***inertia*** and the ***principal directions*** for the mass-canter G.
   b) ***Show*** that the eigenvector (or modal) matrix found in part (a) diagonalizes the inertia matrix.



2. The figures below show two views of a body with a central cylindrical section and two identical, box-like ends. The central cylindrical section has a diameter of ℓ and length of 10ℓ. The box-like ends have two square sides (length and width equal to 4ℓ) and a depth of ℓ. The cylinder has mass m and the box-like ends each have mass $2m$, so the total mass of the composite shape is $5m$. Find the ***principal moments*** of ***inertia*** and the ***principal directions*** for the point *O*.





Note: In each of the problems, the eigenvalue and eigenvector calculations can be done using MATLAB.

Helpful Observations:

1. If α is an arbitrary scalar, and if λ is an eigenvalue of matrix $[A]$, then $\alpha\lambda$ is an eigenvalue of matrix $\alpha[A]$.
2. If α is an arbitrary scalar, and if $\underset{\sim}{x}$ is an eigenvector of matrix $[A]$, then $\underset{\sim}{x}$ is also an eigenvector of matrix $\alpha[A]$ corresponding to the eigenvalue $\alpha\lambda$.