PROBLEM 1-10

Statement: Convert the template in Problem 1-8 to have and use a set of functions or subroutines that can be called from within any program in that language to solve for the cross-sectional properties of the shapes shown on the page opposite the inside front cover.

Solution: See the page opposite the inside front cover and Mathcad file P0110.

1 Rectangular prism:

Volume $V(a,b,c) := a \cdot b \cdot c$

Mass $M(a,b,c,\gamma) := \dfrac{V(a,b,c)\cdot\gamma}{g}$

Moment about x-axis $I_x(a,b,c,\gamma) := \dfrac{M(a,b,c,\gamma)\cdot\left(a^2 + b^2\right)}{12}$

Moment about y-axis $I_y(a,b,c,\gamma) := \dfrac{M(a,b,c,\gamma)\cdot\left(a^2 + c^2\right)}{12}$

Moment about z-axis $I_z(a,b,c,\gamma) := \dfrac{M(a,b,c,\gamma)\cdot\left(b^2 + c^2\right)}{12}$

2. Cylinder:

Volume $V(r,L) := \pi \cdot r^2 \cdot L$

Mass $M(r,L,\gamma) := \dfrac{V(r,L)\cdot\gamma}{g}$

Moment about x-axis $I_x(r,L,\gamma) := \dfrac{M(r,L,\gamma)\cdot r^2}{2}$

Moment about y-axis $I_y(r,L,\gamma) := \dfrac{M(r,L,\gamma)\cdot\left(3\cdot r^2 + L^2\right)}{12}$

Moment about z-axis $I_z(r,L,\gamma) := \dfrac{M(r,L,\gamma)\cdot\left(3\cdot r^2 + L^2\right)}{12}$

3. Hollow cylinder:

Volume $V(a,b,L) := \pi\cdot\left(b^2 - a^2\right)\cdot L$

Mass $M(a,b,L,\gamma) := \dfrac{V(a,b,L)\cdot\gamma}{g}$

Moment about x-axis $I_x(a,b,L,\gamma) := \dfrac{M(a,b,L,\gamma)}{2}\cdot\left(a^2 + b^2\right)$

Moment about y-axis $I_y(a,b,L,\gamma) := \dfrac{M(a,b,L,\gamma)}{12}\cdot\left(3\cdot a^2 + 3\cdot b^2 + L^2\right)$

Moment about z-axis $I_z(a,b,L,\gamma) := \dfrac{M(a,b,L,\gamma)}{12}\cdot\left(3\cdot a^2 + 3\cdot b^2 + L^2\right)$

4. Right circular cone:

Volume $V(r,h) := \frac{\pi \cdot r^2 \cdot h}{3}$

Mass $M(r,h,\gamma) := \frac{V(r,h) \cdot \gamma}{g}$

Moment about x-axis $I_x(r,h,\gamma) := \frac{3}{10} \cdot M(r,h,\gamma) \cdot r^2$

Moment about y-axis $I_y(r,h,\gamma) := M(r,h,\gamma) \cdot \frac{\left(12 \cdot r^2 + 3 \cdot h^2\right)}{80}$

Moment about z-axis $I_z(r,h,\gamma) := M(r,h,\gamma) \cdot \frac{\left(12 \cdot r^2 + 3 \cdot h^2\right)}{80}$

5. Sphere:

Volume $V(r) := \frac{4}{3} \cdot \pi \cdot r^3$

Mass $M(r,\gamma) := \frac{V(r) \cdot \gamma}{g}$

Moment about x-axis $I_x(r,\gamma) := \frac{2}{5} \cdot M(r,\gamma) \cdot r^2$

Moment about y-axis $I_y(r,\gamma) := \frac{2}{5} \cdot M(r,\gamma) \cdot r^2$

Moment about z-axis $I_z(r,\gamma) := \frac{2}{5} \cdot M(r,\gamma) \cdot r^2$