$$I \quad = \quad \sum M_i {R_i}^2$$

$$I_{\text{central}} = \frac{1}{12} m L^2$$

$$\begin{aligned} I_{\text{shifted}} &= I_{\text{central}} + m x^2 \\ &= \frac{1}{12} m L^2 + m x^2 \end{aligned}$$

$$\begin{aligned} I_{2-\text{rod}} &= I_{\text{central}} + I_{\text{shifted}} \\ &= (\frac{1}{12} m L^2) + (\frac{1}{12} m L^2 + M x^2) \end{aligned}$$

$$\text{surface density} \quad \sigma = \frac{M}{A} = \frac{M}{L^2}$$

$$dM = \sigma * (\text{ area }) = \sigma * (L * dx)$$

$$dI = (\frac{1}{12}\, dM\, L^2) + (dM\, x^2)$$

$$dI = (\frac{1}{12} (\sigma L dx) L^2) + ((\sigma L dx) x^2)$$

$$dI = (\frac{1}{12} \sigma L^3 dx) + (\sigma L x^2 dx)$$

$$I \quad = \quad \sum m_i\, R_i^2$$

$$\text{mass of each little piece} \quad = \quad dm$$

$$I \quad = \quad \int dm\, R^2$$

$$W = \int \vec{F} \cdot d\vec{x} \qquad W = \int \vec{\tau} \cdot d\vec{\theta}$$

$$W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \qquad W = \frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2$$

$$P = \vec{F} \cdot \vec{v} \qquad P = \vec{\tau} \cdot \vec{\omega}$$

$$\vec{F} = m\,\vec{a}$$

$$\vec{\tau} = I\,\vec{\alpha}$$

$$\text{units of } \tau = (\text{kg} * \text{m}^2)\,(\frac{\text{rad}}{\text{s}^2}) = (\frac{\text{kg} * \text{m}}{\text{s}^2})\,(\text{m}) = \text{N} * \text{m}$$

$$|\tau| = |r|\,|F|\,\sin(\theta)$$

$$I_{\text{off}-\text{center}} = I_{\text{central}} + Md^2$$

$$I_{\text{central}} = \frac{1}{12}\,M\,\left(L^2 + L^2\right) = \frac{1}{6}\,M\,L^2$$

$$d = \frac{\sqrt{2}}{2}\,L$$

$$I_{\text{off}-\text{center}} = \frac{1}{6}ML^2 + \frac{1}{2}ML^2 = \frac{2}{3}ML^2$$

$$\lambda(x) = 2\,\frac{\text{kg}}{\text{m}} - 0.5\,\frac{\text{kg}}{\text{m}^3}\,x^2$$

$$dm = \lambda(x)dx = 2\,\frac{\text{kg}}{\text{m}}\,dx - 0.5\,\frac{\text{kg}}{\text{m}^3}\,x^2dx$$

$$dI \quad = \quad dm\ x^2 \quad = \quad 2\ \frac{\mathrm{kg}}{\mathrm{m}}\, x^2 dx \ - \ 0.5\ \frac{\mathrm{kg}}{\mathrm{m}^3}\, x^4 dx$$

$$I \quad = \quad \int dI \quad = \quad \int_{x=0}^{x=1\ \mathrm{m}} 2\ \frac{\mathrm{kg}}{\mathrm{m}}\, x^2 dx \ - \ \int_{x=0}^{x=1\ \mathrm{m}} 0.5\ \frac{\mathrm{kg}}{\mathrm{m}^3}\, x^4 dx$$

$$I \quad = \quad 2\ \frac{\mathrm{kg}}{\mathrm{m}}\ \left[\frac{1}{3}\,(1\,\mathrm{m})^3\right] \ - \ 0.5\ \frac{\mathrm{kg}}{\mathrm{m}^3}\ \left[\frac{1}{5}\,(1\,\mathrm{m})^5\right]$$