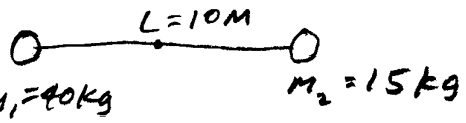
4. (a) What is the moment of inertia about the center of a 10 m long weightless bar if it has a 40 kg mass on one end and a 15 kg mass on the other end? (b) What is the moment of inertia about the heavy end? (c) What is the moment of inertia about the light end?



$I = \Sigma M_i r_i^2$

$= M_1 r^2 + M_2 r^2$

$= (M_1 + M_2) r^2$

$= (40\text{kg} + 15\text{kg})(5\text{m})^2$

a) $\boxed{I_{center} = 1380\ \text{kg m}^2}$

$I_H = M_2 L^2$

$= 15\text{kg}(10\text{m})^2$

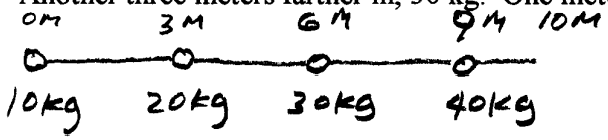
b) $\boxed{I_H = 1500\ \text{kg m}^2}$

$I_L = M_1 L^2$

$= 40\text{kg}(10\text{m})^2$

c) $\boxed{I_L = 4000\ \text{kg m}^2}$

5. A weightless bar 10 meters long has 4 point masses on it. At the left end, 10 kg. Three meters in, 20 kg. Another three meters farther in, 30 kg. One meter from the right end, 40 kg. Where is the center of mass?



$\boxed{X_{cm} = 6\text{ M}}$

$X_{cm} = \frac{\Sigma M_i r_i}{\Sigma M_i}$

$= \frac{M_1 r_1 + M_2 r_2 + M_3 r_3 + M_4 r_4}{M_1 + M_2 + M_3 + M_4}$

$= \frac{20\text{kg}(3\text{m}) + 30\text{kg}(6\text{m}) + 40\text{kg}(9\text{m})}{10\text{kg} + 20\text{kg} + 30\text{kg} + 40\text{kg}}$

6. A torque of 10 Nm is available to rotate a 100 gram meter stick. What angular acceleration will it produce about the center? About one end?

$\tau = I\alpha$

$\tau = \frac{1}{12} ML^2 \alpha$

$\alpha = \frac{12\tau}{ML^2}$

$= \frac{12(10\text{Nm})}{0.1\text{kg}(1\text{m})^2}$

$\boxed{\alpha = 1200\ \frac{\text{rad}}{\text{s}^2}}$

$\tau = \frac{1}{3} ML^2 \alpha$

$\alpha = \frac{3\tau}{ML^2}$

$= \frac{3(10\text{Nm})}{0.1\text{kg}(1\text{m})^2}$

$\boxed{\alpha = 300\ \frac{\text{rad}}{\text{s}^2}}$