$$I = \int r^2 \, dm$$

$$\lambda = \frac{M}{L} \, , \quad dm = \lambda \, dr$$

$$dm = \frac{M}{L} \, dr$$

$$I = \int r^2 \frac{M}{L} \, dr = \frac{M}{L} \int_{-\frac{L}{2}}^{\frac{L}{2}} r^2 \, dr$$

$$= \frac{M}{L} \left[\frac{1}{3} r^3 \right]_{-\frac{L}{2}}^{\frac{L}{2}} = \frac{1}{3} \frac{M}{L} \left[\left(\frac{L}{2}\right)^3 + (+1)^{\cancel{3}} \left(\frac{L}{2}\right)^3 \right]$$

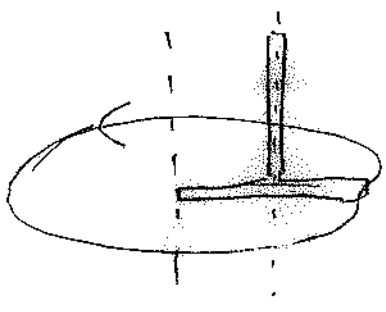
$$= \frac{1}{3} \frac{M}{L} \left[\frac{L^3}{8} + \frac{L^3}{8} \right] = \frac{1}{12} M L^2$$

$$I = \int x^2 \, dm = \int (x' + D)^2 \, dm$$

$$= \int (x'^2 + 2x'D + D^2) \, dm$$

$$= \int x'^2 \, dm + 2D \int x' \, dm + \int D^2 \, dm$$

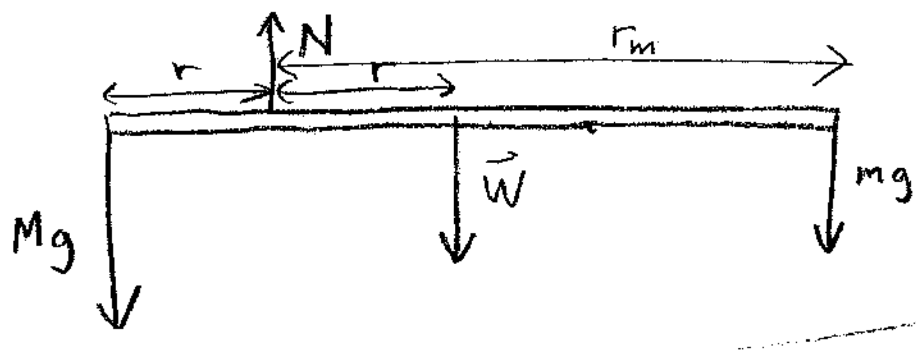
$$I = I_{cm} + 0 + M D^2$$



$$I = \frac{1}{3}ML^2 + \left(I_{cm} + M\left(\frac{L}{2}\right)^2\right)$$

$$= \frac{1}{3}ML^2 + \frac{1}{4}ML^2$$

$$\Sigma F = 0 \quad , \quad \Sigma \tau = 0$$



$M_b = 2m$

$r_m = 3r$

$$N - Mg - M_b g - mg = 0$$

$$Mgr - M_b gr - mgr_m = 0$$

$$Mgr = M_b gr + mgr_m = 2mgr + mgr_m$$

$$M = \frac{2mgr + mgr_m}{gr}$$

$$M = \frac{2mgr + 3mgr}{gr} = \frac{5m\cancel{gr}}{\cancel{gr}} = 5m$$

$$N = Mg + 2mg + mg = 5mg + 2mg + mg$$

$$N = 8mg$$

$$\Sigma \tau = I\alpha$$

$$\frac{M}{2} g r - M_b g r - m g r_m = I\alpha$$

$$\frac{5m}{2} g r - 2mgr - 3mgr = I\alpha$$

$$= \left(\frac{5}{2} - 2 - 3\right) mgr = I\alpha$$

$$-\frac{5}{2} mgr = I\underline{\alpha}$$

$$I = I_{cm} + M_b r^2 = \frac{1}{12} M_b (4r)^2 + M_b r^2$$

$$I = \frac{16}{12} M_b r^2 + M_b r^2 = \frac{4}{3} M_b r^2 + M_b r^2$$

$$I = \frac{7}{3} M_b r^2 = \frac{7}{3}(2m) r^2 = \frac{14}{3} m r^2$$

$$\alpha = \frac{-\frac{5}{2} mgr}{I} = \frac{-5 \cancel{m} g \cancel{r} \times 3}{2 \times 14 \cancel{m} r^{\cancel{2}}} = \frac{-15 g}{28 r}$$

$$v_i = \omega r_i$$