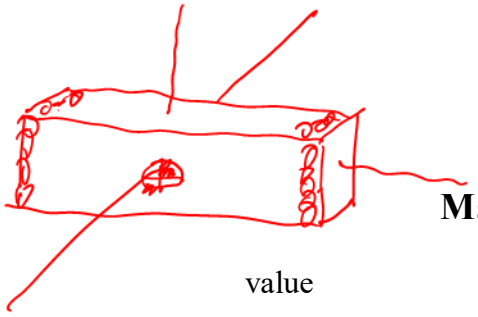
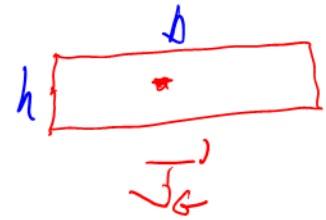


Mass Moment of Inertia Quiz



	value	units	answer
mass m	2.286 lbm = 1.038 kg		
length L	24 in = 60.96 cm		
width w	3.375 in = 8.573 cm		
thickness t	1.5 in = 3.81 cm		
density ρ	0.01881 lbm/in^3 = 0.5213 g/cm^3		
mass moment J	111.9 lbm.in^2 = 0.777 lbm.ft^2 = 0.290 lbf.in.sec^2 = 328 kg.cm^2 = 3.28 N.cm.sec^2		

1 slug = 32.174 lbm

$m\ell^2$ = lbm.in^2 in.lbf.sec

$T = J\alpha$ in.lbf = ( ) rad/sec

b = 24 in h = 3.375 in m = 2.286 lbm

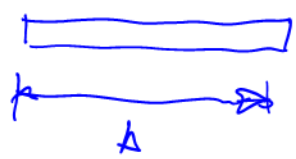
rect

$J_G = m\,(b^2 + h^2) / 12 = 111.9$ lbm.in^2 $= 111.9\ \cancel{\text{lbm.in}^2}\left(\dfrac{\text{lbf.sec}^2}{32.174\ \cancel{\text{lbm.ft}}}\right)\left(\dfrac{\cancel{\text{ft}}}{12\ \cancel{\text{in}}}\right) = 0.290$ lbf.in.sec^2

thin rod

$J_G = m\,b^2 / 12 = 109.7$ lbm.in^2 (thin rod)

$$J_G + m a^2 = \frac{m g a \tau^2}{4\pi^2}$$ m = 2.286 lbm a = 12.25 in



<u>in class</u> 20 τ = 25.41 sec τ = 1.2705 sec

$$\frac{m g a \tau^2}{4\pi^2} = \left(\frac{2.286\ \text{lbm}}{4\pi^2}\right)\left(\frac{386\ \text{in}}{\text{sec}^2}\right)(12.25\ \text{in})(1.2705\ \text{sec})^2 = 441.97\ \text{lbm.in}^2$$

$ma^2 = (2.286\ \text{lbm})(12.25\ \text{in})^2 = 343.04$ lbm.in^2

$J_G = 98.93$ lbm.in^2 (-11.6% difference)

<u>20 repetitions</u> 20 τ = 25.63 sec (stdev = 0.0677 sec) τ = 1.2815 sec

$$\frac{m g a \tau^2}{4\pi^2} = \left(\frac{2.286\ \text{lbm}}{4\pi^2}\right)\left(\frac{386\ \text{in}}{\text{sec}^2}\right)(12.25\ \text{in})(1.2815\ \text{sec})^2 = 449.65\ \text{lbm.in}^2$$

$ma^2 = (2.286\ \text{lbm})(12.25\ \text{in})^2 = 343.04$ lbm.in^2

J_G = 106.6 lbm.in^2 (-4.7% difference)