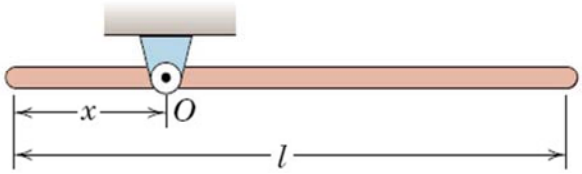
Work-Energy: Exercise 3



Determine the ***distance x*** for which the ***angular velocity*** of the pivoted slender rod will be ***maximum*** as the bar passes the ***vertical position*** after being released from rest in the position shown.

6/135 $T_1 + V_{1-2} = T_2$

$$mg\left(\frac{l}{2}-x\right) = \frac{1}{2}\left[\frac{1}{12}ml^2 + m\left(\frac{l}{2}-x\right)^2\right]\omega^2$$

$$\omega^2 = \frac{g\left(\frac{l}{2}-x\right)}{\frac{l^2}{6} - \frac{lx}{2} + \frac{x^2}{2}}$$

Set $\frac{d\omega^2}{dx} = 0$ & obtain $x = 0.789l$

or $x = 0.211l$

$$\omega_{max} = \omega_{x=0.211} = \sqrt{\frac{g\left(\frac{l}{2} - 0.211l\right)}{\frac{l^2}{6} - \frac{0.211l^2}{2} + \frac{(0.211l)^2}{2}}}$$

$$= 1.861\sqrt{\frac{g}{l}}$$

(The solution $x = 0.789l$ would yield the same ω_{max}, only then the motion is CCW.)