Classical Mechanics : Homework 1

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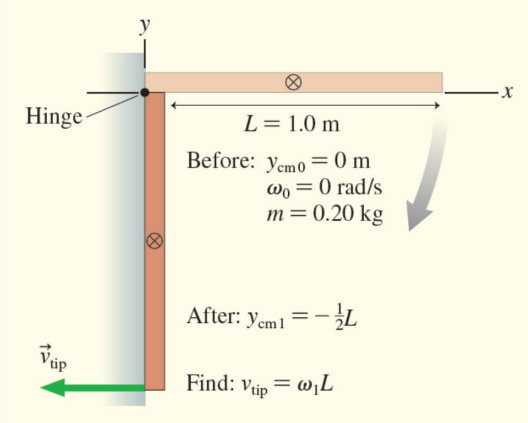
Problem 1 : Rigid Body



Question :
Find $v_{tip} = \omega_1 L$!

Answer :

$$ME_i = ME_f$$

$$\frac{1}{2}I{\omega_i}^2 + Mgy_i = \frac{1}{2}I{\omega_f}^2 + Mgy_f$$

$$\frac{1}{2}I(0) + Mg(0) = \frac{1}{2}I{\omega_f}^2 + Mgy_{cm1}$$

for a rod that rotates at the end ($I = \frac{1}{3}ML^2$)

$$0 = \frac{1}{2}\left(\frac{1}{3}ML^2\right){\omega_f}^2 + Mg\left(-\frac{1}{3}L\right)$$

$$0 = \frac{1}{6}ML^2{\omega_f}^2 - \frac{1}{2}MgL$$

$$\frac{1}{6}L{\omega_f}^2 = \frac{1}{2}g$$

$${\omega_f}^2 = \frac{3g}{L}$$

$$\omega_f = \sqrt{\frac{3g}{L}}$$

$$v_{tip} = \omega_f L$$
$$v_{tip} = \sqrt{\frac{3g}{L}} L$$
$$v_{tip} = \sqrt{3gL}$$
$$v_{tip} = \sqrt{3(9.8)1}$$
$$v_{tip} = 5,42$$

So, v_{tip} at the end of the rod is $5,42$ m/s.