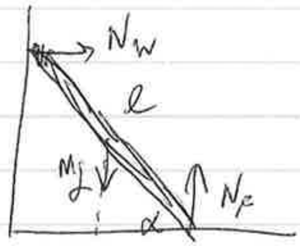
j09m3



energy conserved.

initial, $U = mg\frac{l}{2}\sin\alpha$.

while moving, $U = mg\frac{l}{2}\sin\theta$,

$T_{cm} = \frac{1}{2}MV_{cm}^2 + \frac{1}{2}I_{cm}\dot{\theta}^2$

$x_{cm} = \frac{l}{2}\cos\theta$

$\dot{x}_{cm} = -\frac{l}{2}\sin\theta\dot{\theta}$ $\quad V_{cm}^2 = \left(\frac{l}{2}\right)^2\dot{\theta}^2$

$\dot{y}_{cm} = \frac{l}{2}\cos\theta\dot{\theta}$

$$mg\frac{l}{2}\sin\alpha = mg\frac{l}{2}\sin\theta + \frac{1}{2}m\left(\frac{l}{2}\dot{\theta}\right)^2 + \frac{1}{2}\left(\frac{ml^2}{12}\right)\dot{\theta}^2$$

$$\cancel{m}g\frac{l}{2}\sin\alpha = g\cancel{m}\frac{l}{2}\sin\theta + \frac{ml^2\dot{\theta}^2}{6}\cancel{\left(\frac{1}{8}+\frac{1}{24}\right)}$$

$$\rightarrow g(\sin\alpha - \sin\theta) = \frac{l\dot{\theta}^2}{3} \rightarrow \dot{\theta}^2 = \frac{3g}{l}(\sin\alpha - \sin\theta)$$

$$2\dot{\theta}\ddot{\theta} = \frac{3g}{l}(\cancel{\sin\alpha} - \cos\theta\dot{\theta}) \rightarrow \ddot{\theta} = -\frac{3g}{2l}\cos\theta$$

to solve, find when normal force from vertical wall $= 0$. Since this is the only horizontal force, $N_W = m\ddot{x}_{cm}$, so find when $\ddot{x}_{cm} = 0$.

$\dot{x}_{cm} = -\frac{l}{2}\sin\theta\dot{\theta}$

$$\ddot{x}_{cm} = -\frac{l}{2}\left(\cos\theta\dot{\theta}^2 + \sin\theta\ddot{\theta}\right) = -\frac{l}{2}\left(\frac{3g}{l}\cos\theta(\sin\alpha - \sin\theta) - \frac{3g}{2l}\cos\theta\sin\theta\right) = 0$$

$$\rightarrow \cancel{2\cos\theta\sin\alpha} \quad 2(\sin\alpha - \sin\theta) - \sin\theta = 0$$

$$\rightarrow \sin\theta = \frac{2}{3}\sin\alpha.$$

Initially upright, $\alpha = \frac{\pi}{2} \rightarrow \sin\theta = \frac{2}{3}$.