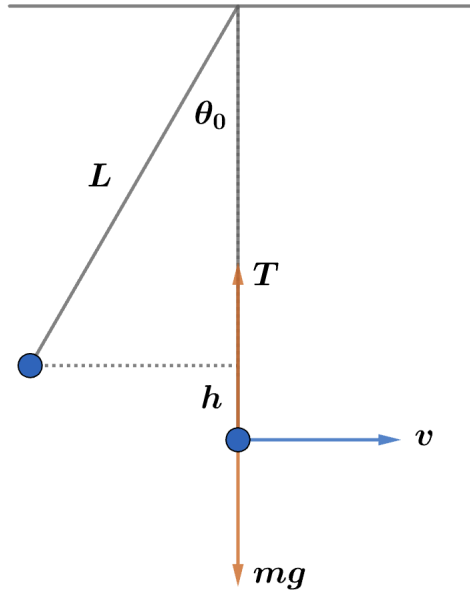


# 2013 F=ma Exam: Problem 20

Kevin S. Huang



We found in the previous problem that the tension is maximized when the pendulum is at the bottom. We have

$$T - mg = \frac{mv^2}{L}$$

Since the pendulum amplitude is  $\theta_0$ , the pendulum has fallen a height

$$h = L(1 - \cos \theta_0)$$

By conservation of energy,

$$\begin{aligned} mgh &= \frac{1}{2}mv^2 \\ v^2 &= 2gh = 2gL(1 - \cos \theta_0) \end{aligned}$$

Substituting this into the force equation,

$$\begin{aligned} T - mg &= 2mg(1 - \cos \theta_0) \\ T &= mg(3 - 2 \cos \theta_0) \end{aligned}$$

so the answer is E.