93. (a) The rotational inertia of a uniform rod with pivot point at its end is $I = mL^2/12 + mL^2 = \frac{1}{3}ML^2$. Therefore, Eq. 16-29 leads to

$$T = 2\pi\sqrt{\frac{\frac{1}{3}ML^2}{Mg(L/2)}} \quad \Longrightarrow \quad L = \frac{3gT^2}{8\pi^2}$$

so that $L = 0.84$ m.

(b) By energy conservation

$$\begin{aligned} E_{\text{bottom of swing}} &= E_{\text{end of swing}} \\ K_m &= U_m \end{aligned}$$

where $U = Mg\ell\,(1 - \cos\theta)$ with ℓ being the distance from the axis of rotation to the center of mass. If we use the small angle approximation ($\cos\theta \approx 1 - \frac{1}{2}\theta^2$ with θ in radians (Appendix E)), we obtain

$$U_m = (0.5)(9.8)\left(\frac{L}{2}\right)\left(\frac{1}{2}\theta_m^2\right)$$

where $\theta_m = 0.17$ rad. Thus, $K_m = U_m = 0.031$ J. If we calculate $(1 - \cos\theta)$ straightforwardly (without using the small angle approximation) then we obtain within 0.3% of the same answer.