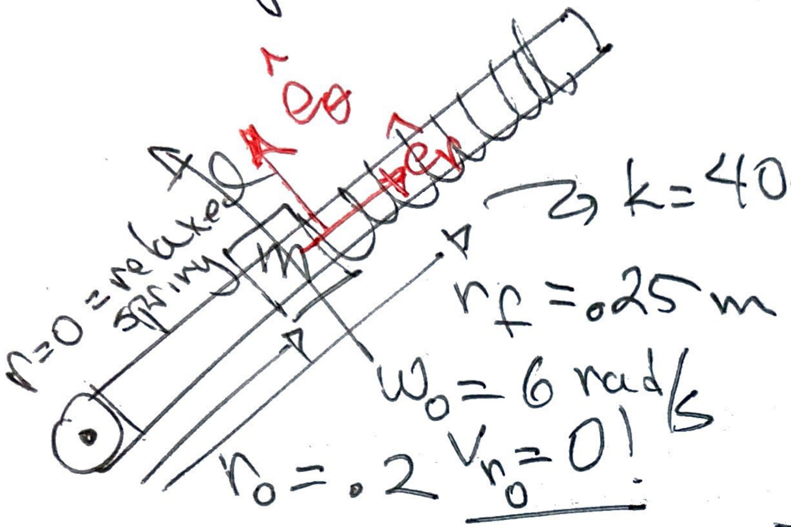
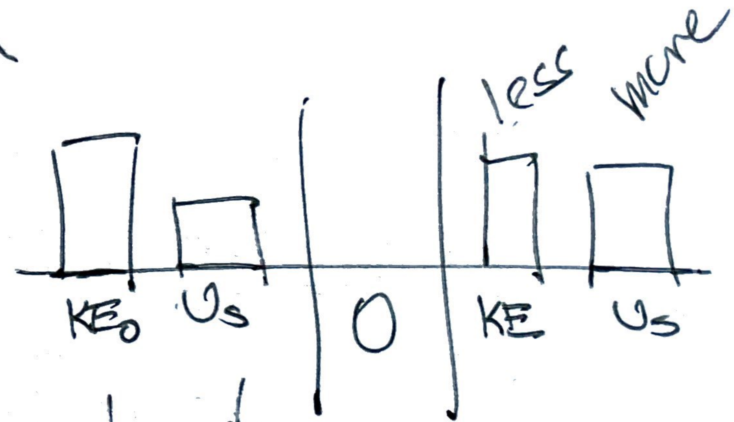
Given



$m = 2\,kg$



Req'd $V_r \big|_{r=.25m}$

Assume: $\mu = 0$

Strategy Energy first, then conservation of angular momentum

Estimate $V_0 = 1.2\,m/s \Rightarrow r m v_\theta = H_0 = .2(2)(1.2) \cong .5\,kgm/s$

$\Rightarrow$ V_r doesn't contribute to H!

$.5 = .25(m)v_{\theta_f} \Rightarrow V_{\theta_f} \cong 1\,m/s \Rightarrow V_r$ is small!

Soln: $KE_0 = \frac{1}{2} m v_0^2 = \frac{1}{\cancel{2}}(\cancel{2}kg)(\underset{.2(6)}{r\omega})^2 m/s = \underline{1.44J}$

$U_{s_0} = \frac{1}{2} k\Delta x^2 = \frac{1}{\cancel{2}} \overset{20}{\cancel{40}} N/m \cdot (.2m)^2 = \underline{.8J}$

$U_{s_f} = \frac{1}{2} k\Delta x^2 = \frac{1}{\cancel{2}} \overset{20}{\cancel{40}} N/m (.25m)^2 = 1.25J$

$KE_0 + U_{s_0} = KE_f + U_{s_f} \Rightarrow 1.44J + .8J = KE_f + 1.25J$

$\Rightarrow 1.44J + .8J - 1.25J = \boxed{KE_f = .99J} = \frac{1}{\cancel{2}} \cancel{m} v_f^2$

$\Rightarrow \boxed{v_f = .995 m/s}$ ← include v_r & v_θ

$v_f = \sqrt{v_\theta^2 + v_r^2}$

Angular Momentum

$\overline{r \times m v} = r m v_\theta = .2(m) 1.2 m/s = .48 kg\, m^2/s$

$\Rightarrow .25m(2kg) v_{\theta_f} = .48 \Rightarrow \underline{v_{\theta_f} = .96 m/s} = r_f \omega_f \Rightarrow \omega_f = \frac{.96 m/s}{.25 m}$

$\Rightarrow \boxed{\omega_f = 3.84\ rad/s}$

Soln: cont

$$V_f^2 = V_\theta^2 + v_r^2 \Rightarrow .99\,m^2/s^2 = (.96\,m/s)^2 + v_r^2$$

$$\Rightarrow v_r^2 = .0684\,m^2/s^2 \Rightarrow v_r = .262\,m/s$$

Discussion: I like the number though it irritates that everything is so close to 1! Matches back of book as well so more confidence!