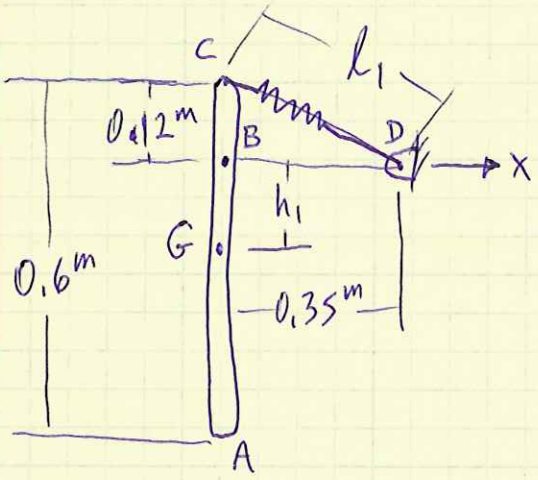
PROB. 17-17

$m = 4^{kg}$, $K = 400 \frac{N}{m}$, $l_u = 0.15^m$, $W_o = 0$

FIND W FOR $\theta = 90°$.

POSITION 1



$l_1 = \sqrt{(0.12)^2 + (0.35)^2} = 0.37^m$

$\Delta l_1 = l_1 - l_u = 0.37 - 0.15$

$\Delta l_1 = 0.22^m$

$h_1 = \frac{1}{2}(0.6) - (0.12) = 0.18^m$

$T_1 = 0$ SINCE $W_o = 0$

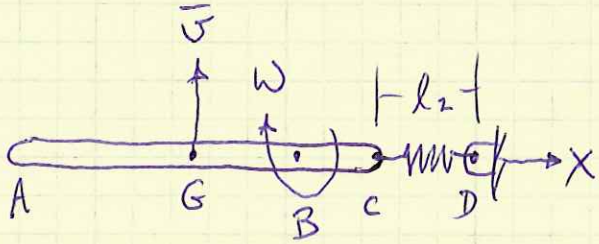
$V_1 = V_e + V_g = \frac{1}{2}K(\Delta l_1)^2 - Wh_1 = \frac{1}{2}K(\Delta l_1)^2 - mgh_1$

$T_2 = \frac{1}{2}m\bar{v}_2^2 + \frac{1}{2}\bar{I}w^2$

$\bar{v}_2 = rw = h_1 w$, $\bar{I} = \frac{1}{12}mL^2$

$T_2 = \frac{1}{2}m(h_1 w)^2 + \frac{1}{2}\left(\frac{1}{12}mL^2\right)w^2 = \frac{1}{2}mw^2\left(h_1^2 + \frac{1}{12}L^2\right)$

$V_2 = V_e + \cancel{V_g}^{\,0} = \frac{1}{2}K(\Delta l_2)^2$



$l_2 = 0.35 - 0.12 = 0.23^m$

$\Delta l_2 = l_2 - l_u = 0.23 - 0.15$

$\Delta l_2 = 0.08^m$

$h_2 = 0$

CONSERVATION OF ENERGY:

$$0 + \tfrac{1}{2}K(\Delta l_1)^2 - mgh_1 = \tfrac{1}{2}mW^2\left(h_1^2 + \tfrac{1}{12}L^2\right) + \tfrac{1}{2}K(\Delta l_2)^2$$

$$W = \sqrt{\frac{\left\{\tfrac{1}{2}K\left[(\Delta l_1)^2 - (\Delta l_2)^2\right] - mgh_1\right\}}{\tfrac{1}{2}m\left(h_1^2 + \tfrac{1}{12}L^2\right)}}$$

$$W = \sqrt{\frac{\left\{\tfrac{1}{2}\left(400\tfrac{N}{m}\right)\left[(0.22^m)^2 - (0.08^m)^2\right] - (4^{kg})\left(9.81\tfrac{m}{s^2}\right)(0.18^m)\right\}}{\tfrac{1}{2}(4^{kg})\left[(0.18^m)^2 + \tfrac{1}{12}(0.6^m)^2\right]}}$$

$$W = 3.273\ \tfrac{RAD}{S}$$