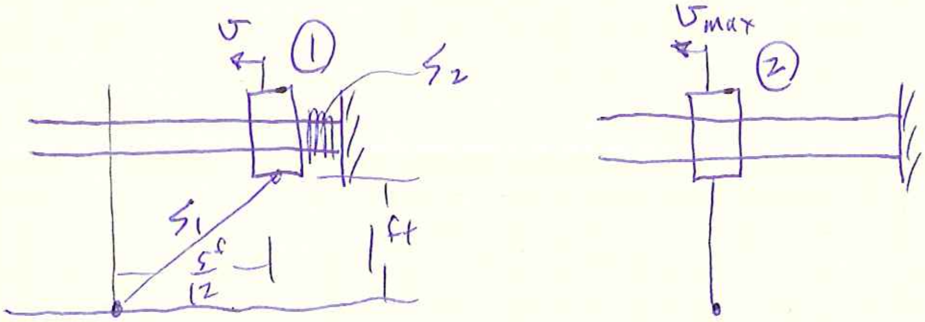
PROB. 13-58

$W = 10^{LB}$, $\Delta X = 5^{IN} = \frac{5}{12}^{ft}$, $X_0 = 12^{IN} = 1^{ft}$,

$K = \left(1.6\frac{LB}{IN}\right)\left(\frac{12\,IN}{ft}\right) = 19.2\ \frac{LB}{ft}$,

a) FIND v_{max} : OCCURS AT EQUILIBRIUM POSITION



AT POINT 1: $\ell_1 = \sqrt{1 + \left(\frac{5}{12}\right)^2} = 1.083^{ft}$

$(\Delta\ell_1)_1 = 1.083 - 1 = 0.08333^{ft}$

$(\Delta\ell_2)_1 = \frac{5}{12}^{ft}$

AT POINT 2: $(\Delta\ell_1)_2 = 0$, $(\Delta\ell_2)_2 = 0$

$T_1 + V_1 = T_2 + V_2$

AT POINT 1: $v_1 = 0$, $\therefore T_1 = \frac{1}{2}mv_1^2 = 0$

$V_1 = \frac{1}{2}K_1(\Delta\ell_1)_1^2 + \frac{1}{2}K_2(\Delta\ell_2)_1^2 = \frac{K}{2}\left[(\Delta\ell_1)_1^2 + (\Delta\ell_2)_1^2\right]$

AT POINT 2: $T_2 = \frac{1}{2}mv_2^2 = \frac{1}{2}\frac{W}{g}v_2^2$, $V_2 = 0$

$0 + \frac{K}{2}\left[(\Delta\ell_1)_1^2 + (\Delta\ell_2)_1^2\right] = \frac{1}{2}\frac{W}{g}\cdot v_2^2$

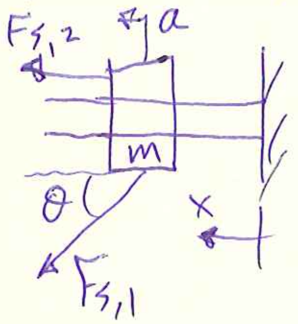
$v_2 = \sqrt{\frac{Kg}{W}\left[(\Delta\ell_1)_1^2 + (\Delta\ell_2)_1^2\right]}$

PROB. 13-58 CONT.

$$v_2 = \sqrt{\frac{\left(19.2\ \frac{LB}{ft}\right)\left(32.2\ \frac{ft}{s^2}\right)}{\left(10\ LB\right)} \cdot \left[\left(0.08333\ ft\right)^2 + \left(\frac{5}{12}\ ft\right)^2\right]}$$

$$\boxed{v_2 = 3.341\ \frac{ft}{s}}$$

b) FIND a_{max}: OCCURS AT POINT 1:



$$\theta = TAN^{-1}\left(\frac{12}{5}\right) = 67.38°$$

$$\Sigma F_x = m a_x$$

$$F_{s,2} + F_{s,1} \cdot \cos\theta = \frac{W}{g} \cdot a_{max}$$

$$K(\Delta l_2)_1 + K(\Delta l_1)_1 \cdot \cos\theta = \frac{W}{g} \cdot a_{max}$$

$$a_{max} = \frac{gK}{W}\left[(\Delta l_2)_1 + (\Delta l_1)_1 \cdot \cos\theta\right]$$

$$a_{max} = \frac{\left(32.2\ \frac{ft}{s^2}\right)\left(19.2\ \frac{LB}{ft}\right)}{\left(10\ LB\right)} \cdot \left[\left(\frac{5}{12}\right)^{ft} + \left(0.08333\ ft\right) \cdot \cos 67.38°\right]$$

$$\boxed{a_{max} = 27.74\ \frac{ft}{s^2}}$$