PROB. 13-72

$W = 1.2^{LB}$, $K = 1.8 \frac{LB}{IN} = 21.6 \frac{LB}{ft}$, $l_u = 8^{IN} = \frac{2}{3}$ ft, $v_B = 0$

a) FIND v_C

$T_B + (V_e)_B + (V_g)_B = T_C + (V_e)_C + (V_g)_C$

AT POINT B:

$v_B = 0$

FIND LENGTH OF SPRING AT POINT B:

$A(12, 0, 3)^{IN} = \cancel{4}\ A(1, 0, \frac{1}{4})^{ft}$

$B = (0, 6, 6)^{IN} = B(0, \frac{1}{2}, \frac{1}{2})^{ft}$

$dx = A_x - B_x = 1 - 0 = 1^{ft}$

$dy = A_y - B_y = 0 - \frac{1}{2} = -\frac{1}{2}$ ft

$dz = A_z - B_z = \frac{1}{4} - \frac{1}{2} = -\frac{1}{4}$ ft

$l_{AB} = \sqrt{1 + (\frac{1}{2})^2 + (\frac{1}{4})^2} = \sqrt{1 + \frac{1}{4} + \frac{1}{16}} = \sqrt{\frac{16 + 4 + 1}{16}} = \frac{\sqrt{21}}{4}$ ft

$\Delta X_B = l_{AB} - l_u = \frac{\sqrt{21}}{4} - \frac{2}{3} = 0.4790$ ft

$h_B = \frac{1}{2}$ ft

$T_B = 0$, $(V_e)_B = \frac{1}{2} K (\Delta X_B)^2$, $(V_g)_B = W h_B$

AT POINT C:

FIND LENGTH OF SPRING AT POINT C:

$dx = X_A = 1^{ft}$, $dy = Y_A = 0$, $dz = Z_A = \frac{1}{4}$ ft

$l_C = \sqrt{1 + (\frac{1}{4})^2} = \frac{\sqrt{17}}{4}$ ft

$\Delta X_C = l_C - l_u = \frac{\sqrt{17}}{4} - \frac{2}{3} = 0.3641$ ft

PROB. 13-72 CONT.

$$T_c = \frac{1}{2} m v_c^2 = \frac{1}{2}\frac{W}{g} v_c^2, \quad (V_e)_c = \frac{1}{2} k (\Delta X_c)^2, \quad (V_g)_c = 0$$

$$0 + \frac{1}{2} k (\Delta X_B)^2 + W h_B = \frac{1}{2}\frac{W}{g} v_c^2 + \frac{1}{2} k (\Delta X_c)^2 + 0$$

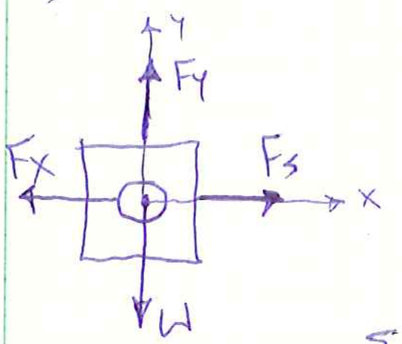
$$v_c = \sqrt{\frac{2g}{W}\left[\frac{1}{2} k (\Delta X_B)^2 + W h_B - \frac{1}{2} k (\Delta X_c)^2\right]}$$

$$v_c = \sqrt{\frac{2g}{W}\left\{\frac{1}{2} k \left[(\Delta X_B)^2 - (\Delta X_c)^2\right] + W h_B\right\}}$$

$$v_c = \sqrt{\frac{2\left(32.2 \frac{ft}{s^2}\right)}{(1.2\ LB)} \cdot \left\{\frac{\left(21.6 \frac{LB}{ft}\right)}{2} \cdot \left[(0.479\ ft)^2 - (0.3641\ ft)^2\right] + (1.2\ LB)\left(\frac{1}{2}\ ft\right)\right\}}$$

$$\boxed{v_c = 9.399\ \frac{ft}{s}}$$

b) FIND FORCE EXERTED BY ROD ON COLLAR AT C:



SPRING FORCE: $F_s = k(\Delta X_c)$

$$F_s = \left(21.6 \frac{LB}{ft}\right)(0.3641\ ft) = 7.864\ LB$$

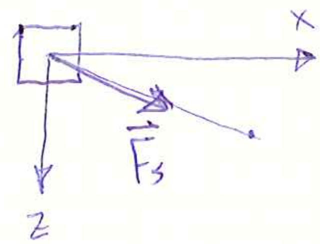
$$\boxed{\cancel{F_x = -F_s = -7.864\ LB}}$$

$$\cancel{\Sigma F_n = m\frac{v^2}{\rho} = \frac{W}{g}\frac{v_c^2}{r}}$$

$$\cancel{F_y - W = \frac{W}{g}\frac{v_c^2}{r}}$$

$$\cancel{F_y =}$$

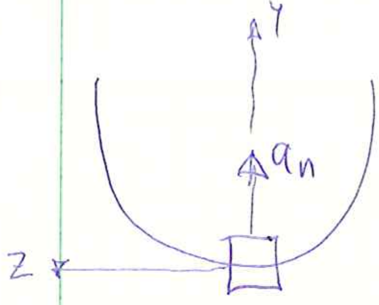
PROB. 13-72 CONT.



$F_x = F_s \cdot \cos\theta$

$\theta = \tan^{-1}\left(\frac{3}{12}\right) = 14.04^\circ$

$$\boxed{F_x = (7.864)\cos 14.04^\circ = 7.629^{LB}}$$



$\Sigma F_n = m\frac{v^2}{\rho} = \frac{W}{g}\cdot\frac{v_c^2}{r}$

$F_y - W = \frac{W}{g}\cdot\frac{v_c^2}{r}$

$F_y = W\left(1 + \frac{1}{g}\cdot\frac{v_c^2}{r}\right)$

$F_y = (1.2^{LB})\left[1 + \frac{1}{\left(32.2\frac{ft}{s^2}\right)}\cdot\frac{\left(9.399\frac{ft}{s}\right)^2}{\left(\frac{1}{2}ft\right)}\right]$

$$\boxed{F_y = 7.784^{LB}}$$