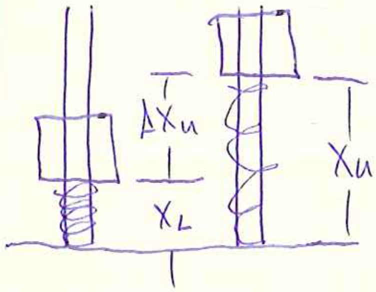
PROB. 13-62

$m = 3\,kg$, $\Delta X = 150^{mm} = 0.15^{m}$, $K = 2.6\,\frac{kN}{m} = 2600\,\frac{N}{m}$

a) FIND h

FIRST FIND UNDEFLECTED SPRING LOCATION



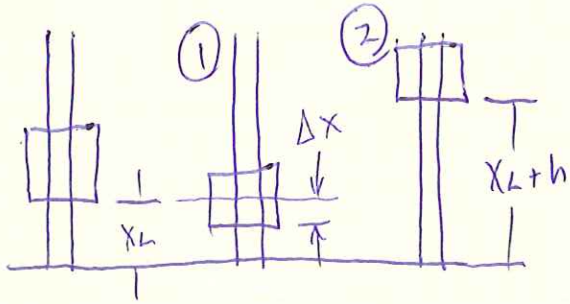
AT EQUILIBRIUM POINT,

$$F_s = mg$$

$$K \Delta X_u = mg$$

$$\Delta X_u = \frac{mg}{K} = \frac{(3^{kg})(9.81\,\frac{m}{s^2})}{(2600\,\frac{N}{m})} = 0.01132^{m}$$

NOW DEPRESS SPRING AND RELEASE



TOTAL DEFLECTION FROM UNDEFLECTED POSITION:

$$\Delta X_T = \Delta X_u + \Delta X = 0.01132 + 0.15 = 0.1613^{m}$$

$$T_1 + V_1 = T_2 + V_2 \;;\; T_1 + (V_g)_1 + (V_e)_1 = T_2 + (V_g)_2 + (V_e)_2$$

AT POINT 1: $v_1 = 0 \therefore T_1 = 0$, $(V_g)_1 = 0$ (DATUM)

$$(V_e)_1 = \frac{1}{2} K (\Delta X_T)^2$$

AT POINT 2: $v_2 = 0, \therefore T_2 = 0$, $(V_g)_2 = mg(h + \Delta X)$,

$(V_e)_2 = 0$ (ASSUME MASS IS ABOVE UNDEFLECTED POSITION)

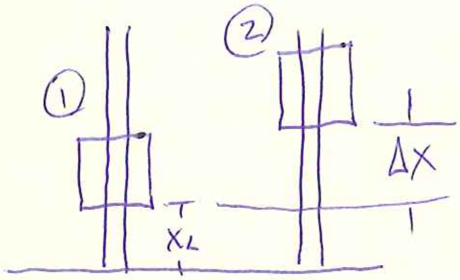
PROB. 13-62 CONT.

$$0 + 0 + \tfrac{1}{2}K(\Delta X_T)^2 = \overset{0+}{m}g(h+\Delta x) + 0$$

$$h = \frac{K}{2mg}(\Delta X_T)^2 - \Delta X$$

$$h = \frac{\left(2600\,\frac{N}{m}\right)}{2(3^{kg})\left(9.81\,\frac{m}{s^2}\right)}\cdot\left(0.1613^{m}\right)^2 - \left(0.15^{m}\right) \boxed{= 0.9995^{m}}$$

b) FIND U_{max}: OCCURS AT EQUILIBRIUM POSITION $(a=0)$



$$T_1 + (V_g)_1 + (V_e)_1 = T_2 + (V_g)_2 + (V_e)_2$$

$$U_1 = 0 \therefore T_1 = 0,\ (V_g)_1 = 0$$

$$(V_e)_1 = \tfrac{1}{2}K(\Delta X_T)^2$$

$$T_2 = \tfrac{1}{2}mU_2^2,\ (V_g)_2 = mg\Delta X,\ (V_e)_2 = \tfrac{1}{2}K(\Delta X_u)^2$$

$$0 + 0 + \tfrac{1}{2}K(\Delta X_T)^2 = \tfrac{1}{2}mU_2^2 + mg\Delta X + \tfrac{1}{2}K(\Delta X_u)^2$$

$$U_{max} = \sqrt{\frac{2}{M}\left[\frac{K}{2}\left[(\Delta X_T)^2 - (\Delta X_u)^2\right] - mg\Delta X\right]}$$

$$U_{max} = \sqrt{\frac{2}{(3^{kg})}\left\{\frac{\left(2600\,\frac{N}{m}\right)}{2}\left[\left(0.1613^{m}\right)^2 - \left(0.01132^{m}\right)^2\right] - (3^{kg})(9.81)(0.15)\right\}}$$

$$\boxed{U_{max} = 4.415\,\frac{m}{s}}$$