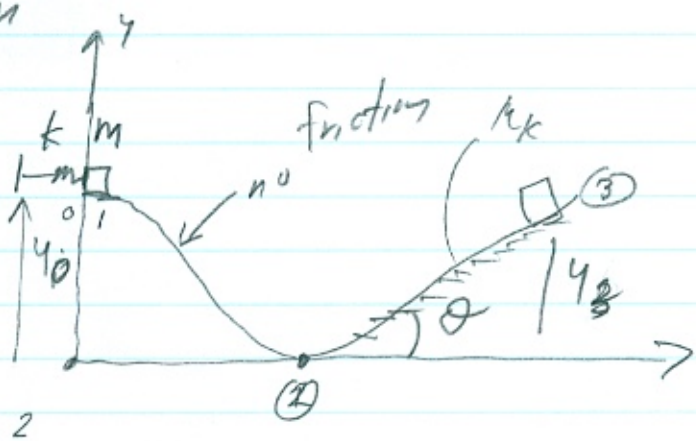
Problem 10.45 (Knight) 3-16-21

$m = 100\ kg$, $k = 80{,}100\ N/m$

$\mu_k = 0.15$

$x_0 = 0.5\ m$ (spring compressed)



(0) → (1) energy is conserved

$$E = \frac{1}{2}mv^2 + mgy + \frac{1}{2}kx_1^2$$

$$E_0 = mgy_0 + \frac{1}{2}kx_0^2 \qquad v_0 = 0,$$

$$E_1 = mgy_1 + \cancel{\frac{1}{2}kx_1^2}^{\,0} + \frac{1}{2}mv_1^2 \qquad y_1 = y_0,\ x_1 = 0$$

$$E_0 = E_1$$

$$\cancel{mgy_0} + \cancel{\frac{1}{2}}kx_0^2 = \cancel{mgy_1} + \cancel{\frac{1}{2}}mv_1^2$$

$$v_1 = \sqrt{\frac{k}{m}}x_0 = \sqrt{\frac{80{,}000}{100}}(0.5) = \boxed{14.14\ m/s}$$

(1) → (2) energy conserved $E_0 = E_2 = E_1$

$$mgy_0 + \frac{1}{2}kx_0^2 = \frac{1}{2}mv_f^2$$

(2) → (3) energy not conserved

Use $W_{NC} = E_f - E_i$

$$W_f = E_3 - E_0$$