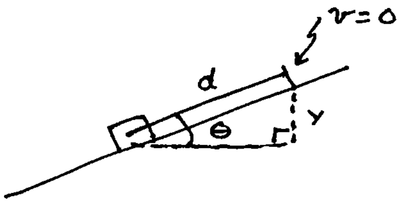
Problem 8-37

(a)



Use conservation of energy. KE at top is zero.

$\therefore \frac{1}{2} m v_0^2 = mgy + E_{thermal}$ [1]

$E_{thermal} = -$ Work done by friction

$= F_K d$

$= \mu_k N d$

But $N = mg\cos\theta$ (as in Exercise 8-16, 8-17, & 8-18)

$\therefore E_{thermal} = \mu_k mg \cos\theta \, d$

$\therefore$ [1] $\Rightarrow \frac{1}{2} m v_0^2 = mgy + \mu_k mg \cos\theta \, d$

Then, $y = d \sin\theta$

$\therefore \frac{1}{2} m v_0^2 = mgd\sin\theta + \mu_k mg\cos\theta \, d$ [2]

$$\therefore d = \frac{v_0^2}{2g(\sin\theta + \mu_k \cos\theta)}$$

$\rightarrow d = 1.21$ m $\quad (1.21_3$ m$)$

(b) Coming down, total distance $D = (1.21_3 + 2.00)$ m

$= 3.21_3$ m

KE at bottom = P.E. at top $- E_{thermal}$

$\therefore \frac{1}{2} m v_f^2 = mgD\sin\theta - \mu_k mg\cos\theta \, D$

(similar to Eq. [2])

$\therefore v_f = \sqrt{2Dg(\sin\theta - \mu_k \cos\theta)}$

$\rightarrow v_f = 4.54$ m/s