Chapter 8

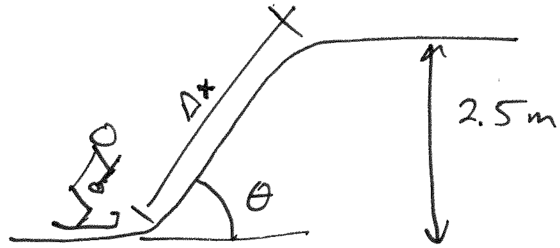
Problem 60

$m = 60.0\ kg$

$v_0 = 12.0\ m/s$

$h = 2.50\ m$

$\mu = 0.80 \qquad \theta = 35°$



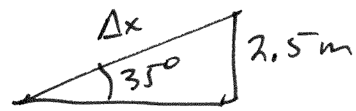
Find the skier's final speed at the top of the slope

Using the work-energy theorem

$$W_{net} = \Delta K \rightarrow W_f + W_g = \Delta K \rightarrow W_f = \Delta K + \Delta U$$

$\Delta U = mgh$ (potential from gravity)

$W_f = -\mu N \cdot \Delta x$ → where Δx is the distance traveled up the slope



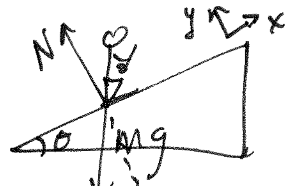
using trig.

$$\sin\theta = \frac{opp}{hyp}$$

$$hyp = \frac{opp}{\sin\theta}$$

$$\therefore\ \Delta x = \frac{2.5}{\sin 35°} = 4.36\ m$$

Normal force needs to be determined from a free-body diagram



$$\sum \vec{F} = m\vec{a}$$

$$\vec{N} + \vec{W} + \vec{F}_f = m\vec{a}$$

$$N\hat{j} - mg\sin\theta\,\hat{i} - mg\cos\theta\,\hat{j} - F_f\hat{i} = ma\,\hat{i}$$

x-dir) $-mg\sin\theta - F_f = ma$

y-dir) $N - mg\cos\theta = 0 \rightarrow \therefore\ N = mg\cos\theta$

Now we have $W_f = -\mu mg\cos\theta\,\Delta x$

$$\Delta U = mgh$$

$$\Delta K = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_0^2$$

So from $W_f = \Delta K + \Delta U$

$$-\mu mg\cos\theta\,\Delta x = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_0^2 + mgh$$

$$\tfrac{1}{2}mv_f^2 = -\mu mg\cos\theta\,\Delta x + \tfrac{1}{2}mv_0^2 - mgh$$

$$v_f = \sqrt{-2\mu g\cos\theta\,\Delta x + v_0^2 - 2gh} = \sqrt{-2(0.80)(9.8)\cos(35)(4.36) + (12)^2 - 2(9.8)(2.5)}$$

$v_f = 6.24\ m/s$

Final ~~velocity~~ speed is

$v = 6.24\ m/s$