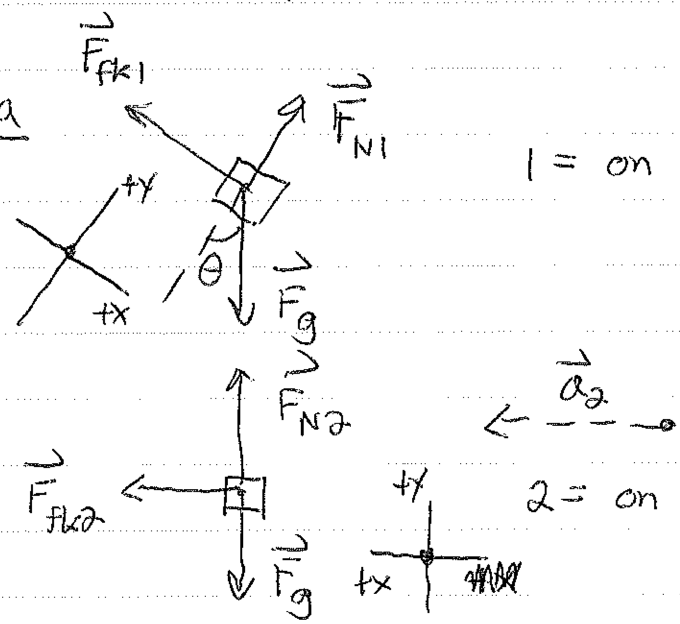
Chapter 06

1a $v = 10.1\,m/s$ $\qquad \Delta t_2 = ?$

$\theta = 15.0^\circ$ $\qquad g = 9.80\,m/s^2$

1b 2-D problem. Ignore the 3rd dimension.
Treat the snowboarder as a particle.
Ignore air resistance.
Newton's laws of motion, mass vs. weight.
Relationship between normal and frictional forces.

2a



$1 =$ on hill $\qquad \vec{a}_1 = 0\,m/s^2$

$2 =$ on horizontal surface

2b $\Sigma \vec{F} = m\vec{a} \qquad F_g = mg \qquad F_{fk} = \mu_k F_N$

3a On hill: $\Sigma F_x = F_g \sin\theta + (-F_{fk1}) = ma_{x} = 0$

$$\Sigma F_y = F_{N1} + (-F_g \cos\theta) = ma_{1y} = 0$$

$F_{N1} = F_g \cos\theta = mg\cos\theta \qquad F_{fk1} = \mu_k F_{N1} = \mu_k mg \cos\theta$

$F_g \sin\theta - F_{fk1} = 0 \qquad mg\sin\theta - \mu_k mg\cos\theta = 0$

$$mg(\sin\theta - \mu_k \cos\theta) = 0 \qquad \frac{\sin\theta}{\cos\theta} = \frac{\mu_k \cos\theta}{\cos\theta} \qquad \tan\theta = \mu_k$$

On horizontal surface:

$$\Sigma F_x = F_{fk2} = ma_{2x} = ma_2$$

$$\Sigma F_y = F_{N2} + (-F_g) = ma_{2y} = 0 \qquad F_{N2} = F_g = mg$$

$$F_{fk2} = \mu_k F_{N2} = \mu_k mg = mg\tan\theta$$

$$mg\tan\theta = ma_2 \quad a_2 = g\tan\theta$$

$$\vec{v}_{f2} = \vec{v}_{i2} + \vec{a}_2 \Delta t_2 \qquad 0 = (-v) + (g\tan\theta)\Delta t_2$$

$$\Delta t_2 = \frac{v}{g\tan\theta} = \frac{(10.1\ m/s)}{(9.80\ m/s^2)(\tan 15.0^\circ)} = 3.85\ s$$

4a The units balance $\frac{m/s}{m/s^2} = s$

The answer is reasonable because 10.1 m/s is about $\left(\frac{10}{25}\right)(60\ MPH) \cong 25\ MPH$, and so slowing down to a stop would take 3 or 4 seconds.