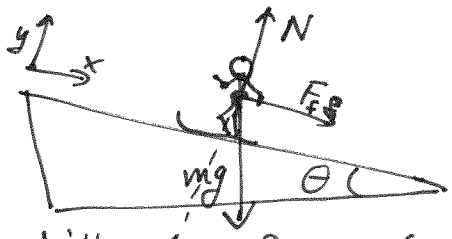
Chapter 6 Problem 54

$\theta = 5.00°$



Find the deceleration of the snowboarder.

Since the snowboarder is going up hill, the force of friction is in the +x direction

Using Newton's 2nd Law

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

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

$$\vec{N} = N\hat{j}$$
$$\vec{W} = mg\sin\theta\,\hat{i} - mg\cos\theta\,\hat{j}$$
$$\vec{F}_f = F_f\,\hat{i}$$
$$\vec{a} = a\,\hat{i}$$

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

x-dir) $mg\sin\theta + F_f = ma \xrightarrow{F_f = \mu N} mg\sin\theta + \mu N = ma$ (#1)

y-dir) $-mg\cos\theta + N = 0 \longrightarrow N = mg\cos\theta$ (#2)

Substitute (#2) into (#1)

$$mg\sin\theta + \mu mg\cos\theta = ma$$

Divide by 'm'

$$a = g\sin\theta + \mu g\cos\theta$$

for waxed wood on wet snow (kinetic) $\mu = 0.100$

Solving for acceleration gives

$$a = (9.80\ m/s^2)\sin(5.00°) + (0.100)(9.80\ m/s^2)\cos(5.00°)$$

$$= 0.854\ m/s^2 + 0.976\ m/s^2$$

$$= \boxed{1.83\ m/s^2}$$

Note: This acceleration is in the +x-direction, which is down hill.

The snow boarder will slow down (decelerate)