Group Problem

A two blocks are connected, as shown at below. The mass of block A is 25 kg, and the mass of block B is 15 kg. The coefficient of static friction between the ramp and block B is .35, and the coefficient of kinetic friction is .22. Determine acceleration of the blocks and the tension in the string.

\[
A: 
\begin{align*}
    m_A g \sin 40^\circ - T - f_A &= m_A a \\
    N_A - m_A g \cos 40^\circ &= 0 \\
    T &= m_A g \sin 40^\circ - f_A - m_A a \\
    f_A &= \mu_k N_A = \mu_k m_A g \cos 40^\circ \\
    &= (0.22)(25)(9.8) \cos 40^\circ \\
    &= 41.29 \text{ N} \\
    f_B &= \mu_k N_B = \mu_k m_B g \cos 30^\circ \\
    &= (0.22)(15)(9.8) \cos 30^\circ \\
    &= 28 \text{ N}
\end{align*}
\]

\[
B: 
\begin{align*}
    T - f_B - m_B g \sin 30^\circ &= m_B a \\
    N_B - m_B g \cos 30^\circ &= 0 \\
    (m_A g \sin 40^\circ - f_A - m_A a) - f_B - m_B g \sin 30^\circ &= m_B a \\
    m_A g \sin 40^\circ - m_B g \sin 30^\circ - f_A - f_B &= m_A a + m_B a \\
    (25)(9.8) \sin 40^\circ - (15)(9.8) \sin 30^\circ - 41.29 - 28 &= 40a \\
    a &= 1.367 \text{ m/s}^2
\end{align*}
\]
A barrel has a mass of 45 kg, and rests between a wall and a ramp, as shown at left. Determine the force exerted on the barrel by the wall and the ramp. (Assume no friction.)

\[ \sum F_x = N_{\text{wall}} - N_{\text{ramp}} \sin 40^\circ = m a \]
\[ \sum F_y = N_{\text{ramp}} \cos 40^\circ - mg = ma \]

\[ N_{\text{ramp}} \cos 40^\circ = mg \]
\[ N_{\text{ramp}} = \frac{mg}{\cos 40^\circ} = \frac{(45)(9.8)}{\cos 40^\circ} = 575 \text{ N} \]
\[ N_{\text{wall}} = N_{\text{ramp}} \sin 40^\circ \]
\[ = (575) \sin 40^\circ = 370 \text{ N} \]

Draw a Free-body diagram for a foot while walking. Make sure you include all of the forces on the foot. Which force propels the person forward? The force the floor exerts on your foot pushes you forward.