Discussion 4: More with Forces

Objective

Practice and gain experience relating force and acceleration.

Problems

There is not room on this worksheet for your work. Use scratch paper.

1. A 3.50-kg block slides uphill at an initial speed of 0.80 meters per second on a ramp at an angle of 25° above horizontal. The coefficient of static friction between the block and the ramp is 0.50, and the coefficient of kinetic friction between the block and the ramp is 0.42.
   a. What is the weight of the block?
   b. What is the component of the block's weight perpendicular to the ramp?
   c. What is the component of the block's weight parallel to the ramp?
   d. What is the magnitude of the normal force on the block?
   e. What is the magnitude of the force of friction on the block?
   f. What is the direction of the force of friction on the block: uphill or downhill?
   g. What is the magnitude of the net force on the block?
   h. What is the direction of the net force on the block?
   i What is the acceleration of the block?
   j. How far does the block slide uphill until it stops?
   k. When the block stops, does it stay at rest, or does it begin to slide back downhill?
   l. If the block slides downhill (it may need a push to start it), what is its acceleration?

2. A block of mass m_1 rests atop a larger block of mass m_2, which is being pulled by a force F along a level surface. The coefficient of static friction between the two blocks is μ_{1s}, and the coefficient of kinetic friction between the large block and the base surface is μ_{2k}.
   a. What is the greatest magnitude of the force F that does *not* make the top block slip off the bottom block? Phrased another way, what is the *least* magnitude of F that *does* make the top block slip?
   b. Let's suppose some reasonable numbers: $m_1 = 1.00$ kg, $m_2 = 4.00$ kg, $\mu_{1s} = 0.45$, and $\mu_{2k} = 0.32$. What is the smallest F that will make the top block slip?