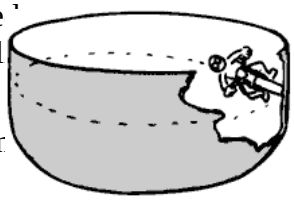
Discussion 5: More practice with forces

Objective

- Gain practice and experience relating force and acceleration.

Problems

1. A motorcycle can ride on the vertical walls of a bowl-shape
track with cylindrical sides. What factors determine its abil
to maintain a level path?



   a. Your first step, of course, is to inventory the forces actir
on the motorcycle and draw a free body diagram.

   b. The free body diagram is one piece of a more expansive project to model what is happening. Discuss with your group and class:

      - What force pulls the motorcycle down the wall? What determines its magnitude and direction?
      - What force pushes the motorcycle up the wall? What determines its magnitude and direction? What magnitude does this force need to keep the motorcycle from sliding down?
      - What force provides the motorcycle's centripetal acceleration? What determines its magnitude and direction? What magnitude does *this* force need to keep the motorcycle from sliding down?

   c. How must the parameters of the system (coefficient of friction, speed of the motorcycle, radius of the cylinder) be related to allow the rider to steadily ride in a level path on the wall?

   d. Pick some reasonable values for radius of the cylinder and coefficient of friction. What is the motorcycle's minimum speed?

   e. Now for a fun puzzler: How far will the motorcycle lean? What is the motorcycle's angle from vertical? (Or from horizontal?)

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}. 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?