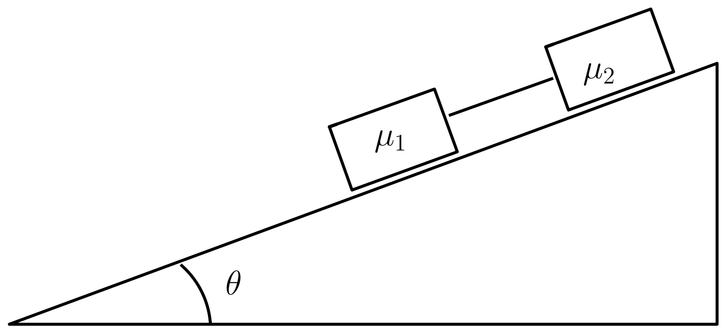
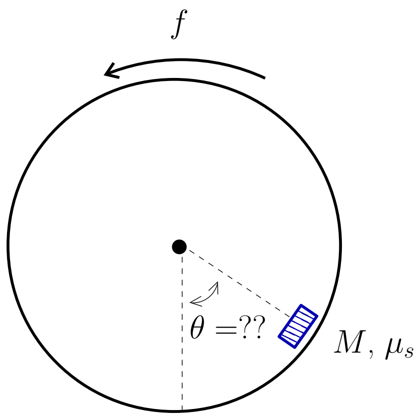
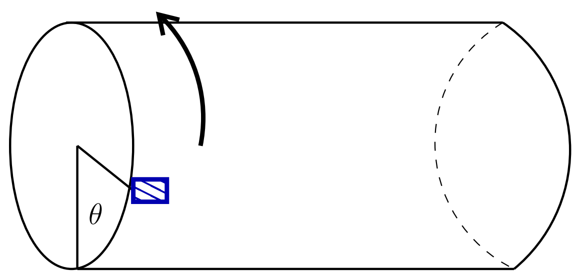
Two blocks of equal mass M are connected by a rope and are allowed to slide down an incline plane of angle θ. The friction coefficients are small, but are not equal and $\mu_1 < \mu_2$ as shown below.



1. Draw a free body diagram of each block
2. Find the acceleration of the system and the tension in the connecting rope
3. When the two friction coefficients are equal what is the tension in the rope. Explain your result physically.
4. What would happen if the two blocks are reversed.

A hollow cylinder of radius R revolves around its center with frequency f (see below). A small block of mass M is held in place by static friction to the inside of the cylinder – the coefficient of static friction is μ_s. As the angle is increased the block breaks free and slides down the inside of the cylinder.





1. Draw a free body diagram of the block just before it breaks free.

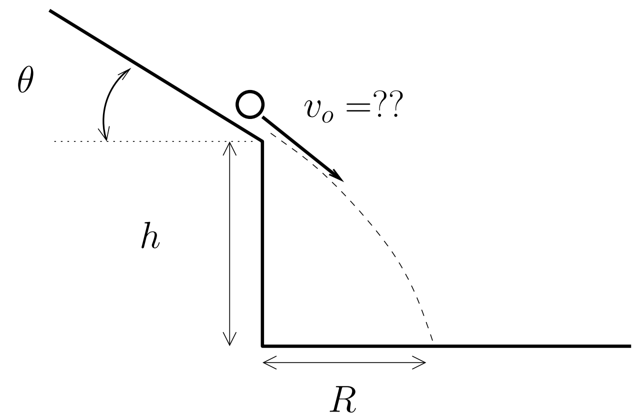
2. On your free body diagram indicate the acceleration vector of the block with a dashed arrow.

3. Determine the angle θ where the block breaks free. Assume that the friction is very small. When friction is small, the angle is small, and you can (should!) make a small angle approximation $\sin(\theta) \simeq \theta$ and $\cos(\theta) \simeq 1$ where θ is in radians.

4. Show that as $\mu_s \simeq 0$ the angle $\theta \simeq 0$ so the approximation scheme is self consistent.

5. **Only after you finish everything else!:** Do not make a small angle approximation and solve for the angle (or $\sin(\theta)$). **Extra-Extra credit:** Show that in the small friction limit you recover the formula in part 3.

A ball rolls off a steep embankment of height h at an angle θ with respect to the horizontal, and lands a distance R from the edge as shown below.



1. Determine the speed v_o of the ball in terms of h, R, θ, g