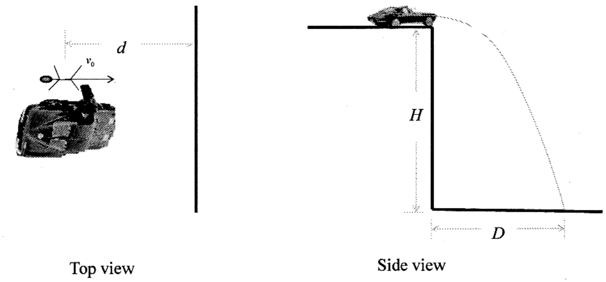
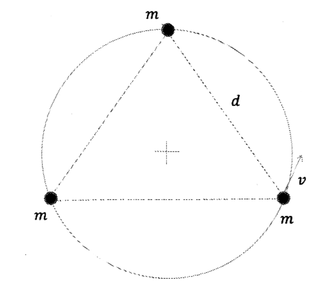
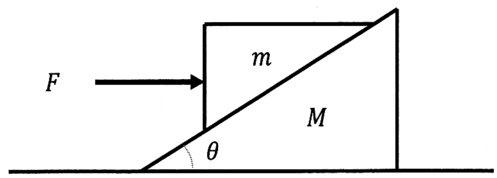
1. In the last Star Trek movie, Young Kirk drops out of a Corvette speeding at velocity, v_0, towards a cliff (see figure to right). [He was taking his uncle's car out for a joyride, a robot cop was chasing him, and his car was heading to a cliff.] Young Kirk slides along the ground and travels a distance, $d = 5\ m$, before stopping right at the edge of the cliff. The car flies off the cliff and after falling a height, $H = 50\ m$, hits the ground, a distance, $D = 30\ m$, from the bottom of the cliff. What is the coefficient of kinetic friction, μ_k, between Young Kirk and the ground? Assume that the car did not slow down after Young Kirk dropped out of it.



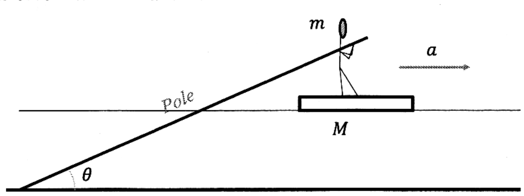


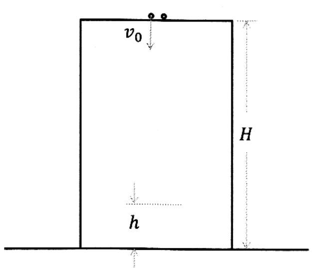
2. Three identical bodies, each with mass, m, orbit around each other under gravity (see figure to the left). The three bodies form an equilateral triangle with side, d. What is the velocity, v, of the bodies expressed in terms of m, d, and G?

3. The figure on the right shows a small, triangular block with mass, m, on top of an incline with mass, M, making an angle, θ, from the horizontal. A force, F, is applied on the small block so that the two blocks do not move relative to one another on a table. If all surfaces are frictionless, find F in terms of m, M, θ, and g.



4. One day, Thelma goes poling on a lake (see figure below). She stands on a raft with mass, M, and pushes along a pole that makes an angle, θ, from the horizontal. Thelma has mass, $m = M/2$. There is a coefficient of static friction, $\mu_s = 3/4$, between Thelma and the raft. If the Thelma does not move relative to the raft, what is the maximum possible acceleration, a, of the raft expressed in terms of θ, and g? Assume that the acceleration is a constant and to the right, and that the pole does not move or slip on the bottom of the lake. There is no friction between the raft and the water.





5. Louise stands on the top of a building with height, $H = 20\ m$, and has an identical superball in each hand (see figure to the left). Superball A is thrown downward with a speed, $v_0 = 5.0\ m/s$, while superball B is simply dropped from the building. Both balls leave her hands at the same time. When the superball A hits the ground, it bounces upward with the same speed that it hits the ground:

$$(v_y)_{right\ before\ ground} = -(v_y)_{right\ after\ ground}$$

Give numerical answers to the following questions.

a. At what time, t_0, does superball A hit the ground?
b. What is the velocity, v_A, at which superball A hits the ground?
c. Eventually, the two balls will be at the same height, h, above the ground. What is this h?