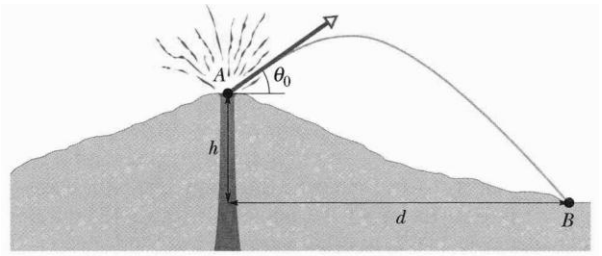
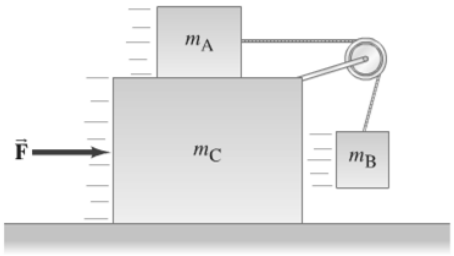
PHYS 7A, Lecture 002, Yildiz
First Midterm, Fall 2010
28 September 2010

1. Relative Motion (15 points). A 200-m-wide river has a uniform flow speed of 1.1 m/s through a jungle and toward the east. An explorer wishes to leave a small clearing on the south bank and cross the river in a powerboat that moves at a constant speed of 4.0 m/s with respect to the water. There is a clearing on the north bank 82 m upstream from a point directly opposite the clearing on the south bank. (a) In what direction must the boat be pointed in order to travel in a straight line and land in the clearing on the north bank? (b) How long will the boat take to cross the river and land in the clearing?

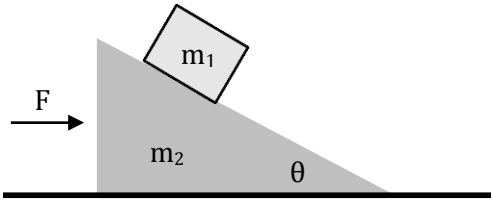
2. Projectile Motion (20 points). During volcanic eruptions, chucks of solid rock can be blasted out of the volcano; these projectiles are called *volcanic bombs*. The figure shows a cross section of Mt. Fuji, in Japan. (a) At what initial speed would a bomb have to be ejected, at angle $\theta_0 = 35°$ to the horizontal, from the vent at A in order to fall at the foot of the volcano at B, at vertical distance $h = 3.30$ km and horizontal distance $d = 9.40$ km? Ignore, for the moment, the effects of air on the bomb's travel. (b) What would be the time of flight?



3. Newton's Laws (20 points). Determine a formula for the magnitude of the force $\vec{F}$ exerted on the large block (m_C) in the figure so that the mass m_A does not move relative to m_C. Ignore all friction. Assume m_B does not make contact with m_C.



4. Friction (25 points). A small block m_1 rests on a triangular wedge of mass m_2 and angle θ, which in turn sits on a horizontal table top. We apply a horizontal force F to m_2. Say that the coefficient of static friction between the block and wedge is μ_s and the coefficient of kinetic friction between the wedge and the table top is μ_k. The wedge will slide on the table for any force F. (a) Find the maximum force F such that the block does not start to slide up the wedge. (b) Assume that in the absence of a force F, the block will start to slide. What is the minimum force that must be applied to prevent the block from sliding down the wedge?



5. Uniform Circular Motion (20 points). In the figure, a 1.34 kg ball is connected by means of two massless strings, each of length L = 1.70 m, to a vertical, rotating rod. The strings are tied to the rod with separation d = 1.70 m and are taut. The tension in the upper string is 35 N. What are the (a) tension in the lower string, (b) magnitude of the net force $\vec{F}_{net}$ on the ball, and (c) speed of the ball? (d) What is the direction of $\vec{F}_{net}$?