Physics 103H Problem Set 2 Due: Friday, September 26, 2003

Students who are interested in enrolling in Physics 105 should solve and hand in these problems. They will be graded and will count towards your 105 grade. This is **in addition** to the normal 103 assignments. If you are in a 103H precept, turn this in in precept on Friday or into Jadwin 208 by 4:30 Friday. If you are in a 103 precept, turn this in to Jadwin 208 by 4:30 Friday. **Please write your name, the name of your precept instructor, and the time of your precept on your homework.**

Problem 1. A block of mass M_1 rests on a block of mass M_2 which lies on a frictionless table (see Fig. 1). The coefficient of friction between the blocks is μ. What is the maximum horizontal force that can be applied to the blocks for them to accelerate without slipping on one another if the force is applied to (a) block 1 or (b) block 2?

Problem 2. The system in Fig. 2 uses massless, frictionless pulleys and massless rope. The coefficient of friction between the masses and horizontal surfaces is μ. Assume that M_1 and M_2 are sliding towards M_3. The force due to gravity is directed down.

a) Draw force diagram for each mass.
b) How are the accelerations related? (Hint: the rope can't stretch.)
c) Find the tension in the rope, T.

Problem 3. A piece of string of length l and mass M is fastened into a circular loop and set spinning about the center of a circle with uniform angular velocity ω. Find the tension in the string. Suggestion: Draw a force diagram for a small piece of the loop subtending a small angle.

Problem 4. This is a trickier one to visualize. Our techniques work fine here if applied carefully. (This one probably **is** typical of 105 – see our text, K & K, for some refinements in applying Newton's laws.) The 45° wedge in Fig. 3 is pushed along a table with constant acceleration A. A block of mass m slides without friction on the wedge. Find its acceleration. The force due to gravity is directed down. Work in the rest frame of the table. Your final answer, the components of $\vec{a}$, should be given in this frame. (Hints: There is an important relation between the position of the wedge and the x and y coordinates of the block. Why **don't** the techniques developed this week work when applied to coordinates of the block **relative** to the wedge?)

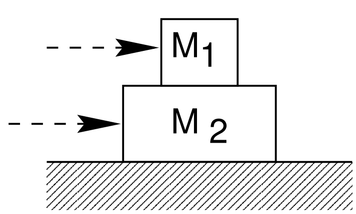

Fig. 1

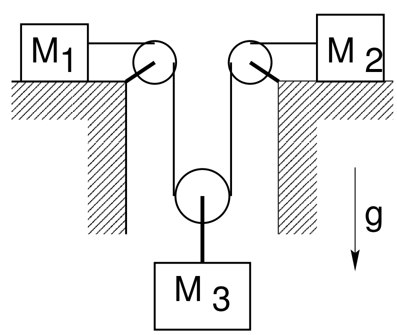

Fig. 2

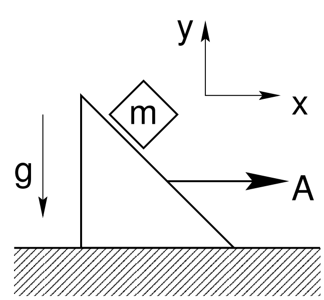

Fig. 3