MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X Fall Term 2001

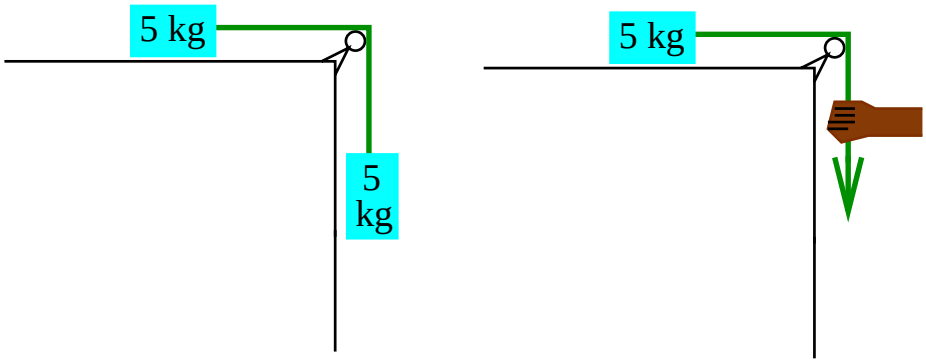
PROBLEM SET 3

Handed out: September 21
Due: September 28 at 5 pm in 4-339B.

Please write your name, subject, recitation number, and the name of the recitation instructor on the top right corner of the first page of your homework solutions. The solutions should be placed in the appropriate box in room 4-339B.

Problem 1:

Two 5 kg bodies are connected by a massless string, as shown in the figure at left. The table is frictionless, and the string passes over a frictionless pulley.



a. Find the acceleration of the masses.

b. Find the tension in the string.

c. Suppose that instead of a 5 kg hanging mass, a person pulls on the string with a force equivalent to the weight of a 5 kg object. Do your answers to parts a. and b. change? Explain.

Problem 2:

A 3 kg block rests on top of a 4 kg block, which rests on a frictionless table. The coefficient of friction between the blocks is such that the blocks start to slip when the horizontal force F applied to the lower block is 24 N. Suppose the horizontal force is now applied only to the upper block. What is its maximum value for the blocks to slide without slipping relative to each other?

Problem 3:

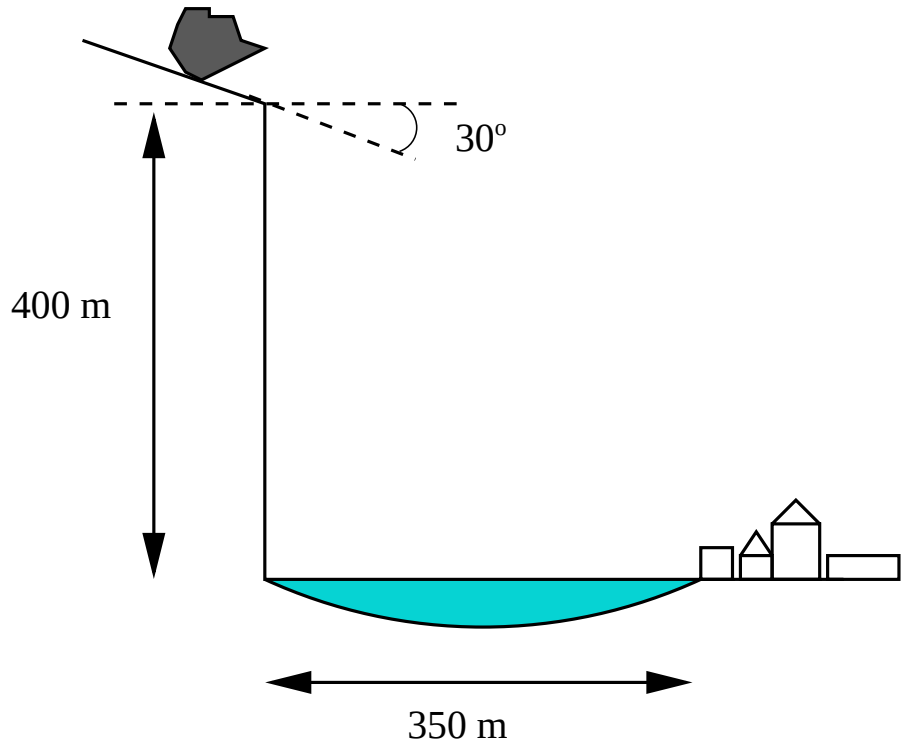
Imagine that you are the mayor of a small village in a scenic mountain valley. A large boulder is positioned on a cliff 400 m above your town, such that if it should roll off, it would leave the cliff with a speed of 50 m/s at an angle of 30 degrees from the horizontal. The town is 350 m away from the base of the cliff, with a lake in between. A geologist tells you that the region has recently become more seismically active, and an earthquake has a significant chance of dislodging the boulder over the next 10 years.

a. Will the boulder hit the village when it lands? Will it hit the lake? (In other words, should you evacuate your citizens?) You can assume that the size of the boulder is negligible compared to either the height of the cliff or the distance between the village and the cliff.

b. How fast will it be going when it hits the ground?

c. What will be the horizontal component of the boulder's velocity when it hits the ground?

d. How long will the boulder be in the air?



Problem 4:

Re-evaluate your answers to parts a. through d. of Problem 3 under the assumption that the village is actually a colony on Mars, where the acceleration of gravity is 3.7 m/s^2. You can assume the velocity of the boulder as it leaves the cliff is still 50 m/s.