# Ph1a - Flipped Section

Problem Sheet 3

October 14, 2019

**1. Leaning ladder**

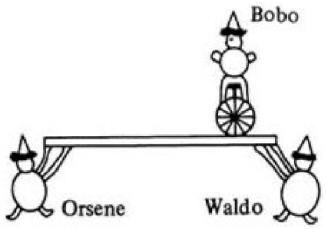
a. (From problem sheet 2) Consider a ladder of uniform mass $m$ and length $d$ which leans against a friction-less wall. The coefficient of static friction between the ground and the ladder is $\mu$. Let $\theta$ be the angle that the ladder makes with respect to the ground. For what angles $\theta$ will the ladder be stable (as opposed to sliding down)?

b. Now, consider the case where the wall is not friction-less. The coefficient of static friction between the ladder and the ground is $\mu_1$ and that between the ladder and the wall is $\mu_2$. For what angles $\theta$ will the ladder be stable?

**2. Three Clowns**

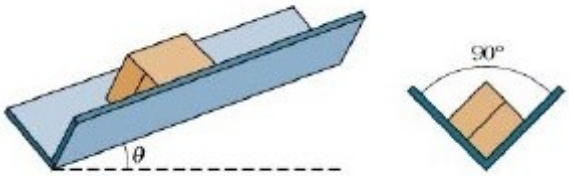
From problem sheet 2 (Frautschi 6.25)

Two clowns, Orsene and Waldo, support a 3 m-long, 10 kg plank while a third, Bobo, rides a unicycle back and forth between the two ends at a steady speed. Bobo and the unicycle together come to 55 kg. If Orsene can't hold masses over 40 kg for more than 5 s, how fast should Bobo ride?




**3. Inclined Trough**

A block slides down a trough formed by two panels joined together at a right angle. When viewed from the front, each panel makes a 45° angle with the horizontal. The coefficient of kinetic friction between the block and a panel is $\mu$. What is the acceleration of the block?



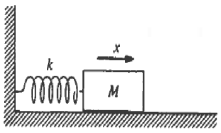
**4. Inclined Block**

Consider a wedge-shaped block of mass $M$, on which sits a smaller mass $m$. (You should really think of the large block as basically an inclined plane, but with finite mass $M$, so that it can potentially move.) The slope of $M$ is at at angle $\theta$ with respect to the ground.

The small block is let go, so that it slides down the slope of the large block. This will in turn push the large block in the opposite direction. What is the acceleration $A$ of the large block? Neglect friction.

**5. Springs**

a. A block of mass $M$ is attached to one end of a horizontal spring, the other end of which is fixed. The block rests on a horizontal friction-less surface. What motion is possible for the block? Write down the equation of motion that describes this motion and the general solution to such an equation.




b. The piston of a spring gun has mass $m$ and is attached to one end of a spring with spring constant $k$. The projectile is a marble of mass M. The piston and marble are pulled back a distance L from the equilibrium position horizontally and suddenly released. What is the speed of the marble as it loses contact with the piston? Neglect friction.