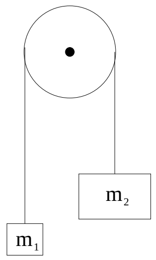
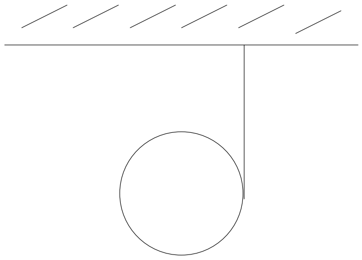
Physics 3344 **Professor Scalise**
Fall 2006 **Assignment #1**

Review of Introductory Mechanics (Due: 24 August 2006)

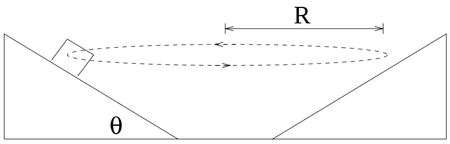
1. An Atwood machine consists of two masses $m_1 < m_2$ suspended over a massless, frictionless pulley by a light inextensible string. Find the acceleration of either mass and the tension in the string.

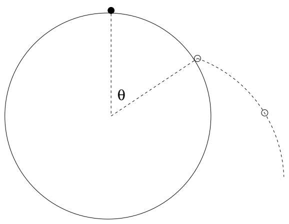




2. A light inextensible string is wrapped several times around a solid cylinder of mass M and radius R while the other end is fixed to the ceiling. As the spool falls, the string unwinds without slipping. Find the acceleration of its center of mass and the tension in the string.

3. Imagine that you are a civil engineer. You need to build a circular track of radius R inclined at an angle θ from the horizontal such that cars traveling at speed v will not slide even if the road surface is covered with ice (frictionless). Find the angle θ.





4. A point particle slides off a frictionless sphere starting from rest at the top $\theta = 0$. At what angle will the particle leave the surface of the sphere?

5. In the undergraduate laboratory, students are asked to balance three masses 150 g, 250 g, and 350 g on a circular force table. Each mass is tied to a string which is run over a pulley and the horizontal section of string is tied to a small ring. When the three string tensions add vectorially to zero, the small ring is in equilibrium. The lab students find the angles between the strings empirically by trial and error (mostly error). Find the following angles mathematically:

   (a) The angle between 150 g and 250 g
   (b) The angle between 250 g and 350 g
   (c) The angle between 350 g and 150 g

   Now suppose that the 350 g mass is replaced by a 450 g mass. Find the same three angles (they will not be real this time).