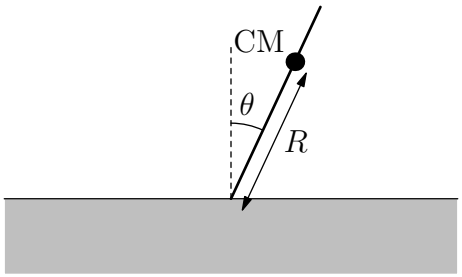
# J04M.3—Falling Stick

## Problem

A thin stick with some arbitrary linear mass density $\mu(x)$ along it is initially at rest. It has one end on a table and makes an angle $\theta_0$ with the vertical. The stick-table contact point has an infinite coefficient of friction.

Let $m$ be the total mass of the stick, $R$ be the distance from the contact point to the center of mass, $I_{CM}$ be the moment about the center of mass, and $g$ be the acceleration due to gravity.




a) The stick is released from rest and allowed to fall to the table. Finad the condition that the end of the stick initially in contact with the table *does* rise from the table as the stick falls. Express the condition in terms of $\theta_0, m, g, R$, and $I_{CM}$.

b) Now consider a specific mass distribution. Let the mass be uniformly distributed along the length. For what range of initial angles $\theta_0$ will the stick eventually lift off the table?

c) Consider a different mass distribution: the mass is concentrated in two points of equal mass, one at either end of the stick. Now for what range of initial angles $\theta_0$ will the stick eventually lift off the table?