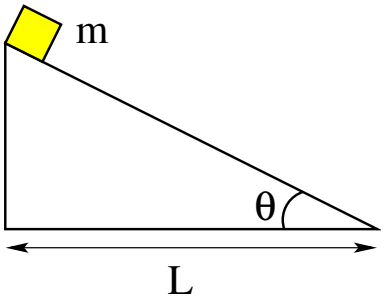
[mex154] Minimizing time of slide when friction is present

A block of mass m slides from rest down a ramp with base of fixed length L as shown. The motion is impeded by a frictional force $f = \mu N$, where N is the normal force and μ is the coefficient of kinetic friction. Show that the angle for which the block arrives at the bottom of the ramp in the shortest time is

$$\theta = \frac{\pi}{4} + \frac{1}{2} \arctan \mu.$$



Solution: