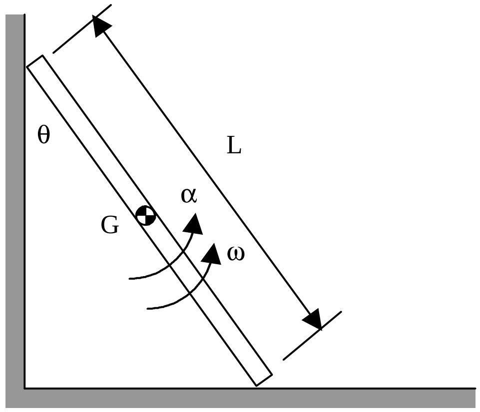
Problem P3

It is very important for you to do these modifications since this problem will be used in Lab #3.



A meterstick having a mass of 0.1 kg is released from rest in the position shown. Model the meterstick as a slender bar and assume it is released from rest at $\theta_0 = 30°$ and all surfaces are frictionless.

Determine:

a) the normal force between the stick and the vertical wall at any angle θ

To check your answer:

when $\theta = 30°$ you should get $\alpha = 7.36$ rad/s^2, and $N_B = 0.32$ N
when $\theta = 40°$ you should get $\alpha = 9.46$ rad/s^2, and $N_B = 0.27$ N

b) Determine the angle the bar will leave the wall assuming the bar is released from rest at angle $\theta_0 = 30°$ (i.e. at what angle will the normal force between the vertical wall and the yardstick to zero). It is helpful to determine the normal force and plot it as a function of θ to get a feel for when it will be zero. Include this plot in your solution.

c) Use the working model simulation you developed in Lab #1 to determine the angle the bar will leave the wall. Be sure to use all the same parameters as used in part b). In your WM simulation define a measure giving the normal force between the wall and the meterstick by selecting both objects and then going to the "Measure" menu and selecting "contact force". Include a snapshot of the simulation at the moment the meterstick leaves the wall.

d) Compare your results from part b) and c)

Hints:

1) You need the angular velocity for any angle θ. The easiest way is to determine this is to use conservation of energy between some starting angle θ_0 and some final angle θ. You should be able to obtain $\omega = \sqrt{\frac{3g}{L}\left(\cos\theta_0 - \cos\theta\right)}$. To save time in solving this problem you may assume this relationship is given (just be sure that you could derive it if asked!)

2) You'll need the acceleration of the center of gravity as a function of θ which you found in problem P2 to be $\vec{a}_G = \frac{L}{2}\left[\left(\alpha\cos\theta - \omega^2\sin\theta\right)\hat{i} - \left(\alpha\sin\theta + \omega^2\cos\theta\right)\hat{j}\right]$. You do not need to rederive this.

3) In you Working Model solution make sure friction is zero.

3) Use Maple to solve the set of equations that you will get.