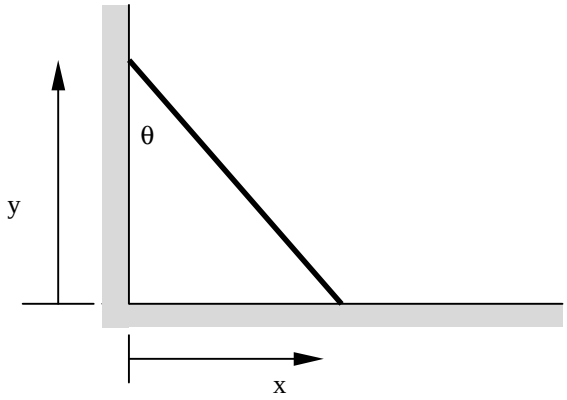
ES204
Mechanical Systems Lab 03

Introduction
This lab/demo is an experiment roughly corresponding to problem 24.2. The purpose is to compare experimental data, analytical results and Working Model results.

Pre-lab
- Bring your Maple worksheet from problem 24.2 and your Working Model simulation from lab 1.
- Read through this write-up.

The experiment we will do as a group
A schematic of the experiment is shown in the figure. We will be trying to determine the location the meterstick leaves the wall. To do this we will use a dry-erase marker to make a big smeary blotch on the board and then see where the mark made by the meterstick disappears. The mass of the meterstick should be written on it.



Task 1 - Initial estimate of friction
The first step is to estimate the coefficient of friction. This can be done by calculating the coefficient of friction based on the maximum value of x and y for which the ruler will stand without falling. Try to come up with way of measuring these values as accurately as possible. The coefficient of friction may then be calculated by considering the static equilibrium of the rod at the critical value of x_c by using the formula:

$$\mu_s = \frac{L - \sqrt{L^2 - x_c^2}}{x_c}$$

This formula assumes the friction on both surfaces is the same. If we assume the vertical wall is frictionless we get, using the critical value of y_c:

$$m_s = \frac{x_c}{2y_c}$$

The coefficient of kinetic friction is usually about 60-80% of the coefficient of static friction. Record your results on the worksheet at the end of this handout.

Task 2 - Experimental Data
Angle of departure
We will measure the angle of departure by attaching a marker to the end of the yardstick and marking on one of the white boards. We will use at least 5 falling events. From the measured distance from the pencil mark to the table you should be able to determine the angle when the meterstick leaves the wall using $\cos\theta = y/L$. Be sure to use a slightly smaller angle than the one you found in Task 1.

Using your Maple worksheet and Working Model with the same starting angle as your experiment, determine the angle of departure using zero friction. Then vary the friction in your WM simulation to match the angle of departure you found from the experiment. Report your results on the worksheet.

Worksheet – ES204 Lab 03

Names _____ _____ _____

Measured Parameters:
Mass of meterstick = _____
Thickness of meterstick = _____

Other measured and calculated values
Friction from static equilibrium
x_c = _____
y_c = _____
θ_c = _____

μ_s = _____(equal friction) estimated μ_k _____ to _____ (60-80% of μ_s)
μ_s = _____(frictionless wall) estimated μ_k _____ to _____ (60-80% of μ_s)

Angle it leaves the surface (just give the average value) Starting angle = _____

Experiment	Maple	WM (no friction)
θ = _____(avg)	θ = _____	θ = _____

Vary the friction in your WM simulation to match the angle of departure you found from the experiment:
μ_k = _____

How does this friction value compare to your estimated value from the static measurement?

Discuss your results here.

Attach a copy of your Maple worksheet and a snapshot of your Working Model simulation.