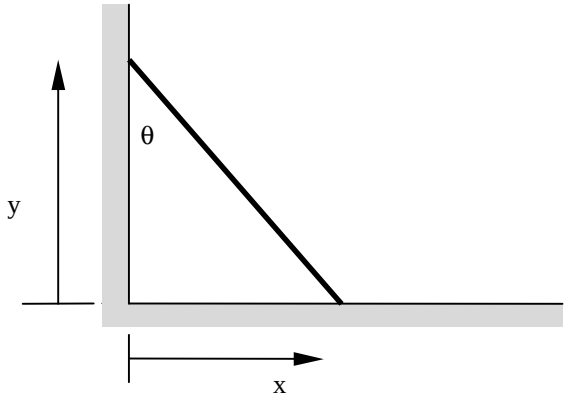
# ES204
# Mechanical Systems Lab 03

**Introduction**
This lab/demo is an experiment roughly corresponding to problem P3. The purpose is to compare experimental data, analytical results and Working Model results.

**Pre-lab**
- Bring your Maple worksheet from problem P3 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.




**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 $\cos\theta = y/L$.

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
$x_c$ = _____
$y_c$ = _____
$\theta_c$ = _____

$\mu_s$ = _____(equal friction) estimated $\mu_k$ _____ to _____ (60-80% of $\mu_s$)
$\mu_s$ = _____(frictionless wall) estimated $\mu_k$ _____ to _____ (60-80% of $\mu_s$)

Angle it leaves the surface (just give the average value)

| Experiment | Maple | WM (no friction) |
|---|---|---|
| $\theta$ = _____(avg) | $\theta$ = _____ | $\theta$ = _____ |

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

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.