$\boxed{\text{Mathematica Homework \#3}}$

Email notebook to corbin@physics.ucla.edu
with a subject line: [Physics 105A]
Due on or about Friday, 5 Feb

- In the first cell, enter all the usual stuff: your **name**, **student ID**, **email address** and the **assignment identifier** (eg. "HW3").
- 1) Bungee Jumping: Construct a pendulum out of an ideal, massless spring of natural length a, spring constant k and a small mass m. Use Mathematica to obtain the relevant equations of motion and plot the resulting trajectory (an animation might be kind of cool too!). Experiment a little with the tunable parameters and see what you can come up with.
- 2) A pendulum is constructed by attaching a mass m to an extensionless string of length L. The upper end of the string is connected to the uppermost point on a cylinder of radius R ($R < L/\pi$) that is oriented so that its longitudinal axis is horizontal. The mass is released at rest with the string taut and horizontal...
  - i) Obtain the pendulum's equation of motion.
  - ii) Assuming the longitudinal axis of the cylinder lies along the z-axis, plot the trajectory of the mass through the x, y plane.
  - iii) Animate the motion of the mass along that trajectory. Extra consideration if you include the circular cross-section of the cylinder and an accurate representation of the string in your animation.
- 3) A point-mass m is bound to another point mass M by gravity. Using Euler-Langrange, find their equations of motion in some general inertial frame of reference, and then, perhaps, relative to their common center-of-mass. It might be fun to animate this, too. If you really want to be ambitious, throw in a switch that allows you to toggle the frame of reference. The hardest part might be finding values that result in an animation where the masses look bound - taking $M >> m$ and G relatively large (who says you have to work in MKS?) should do it, if the initial velocities aren't too large.