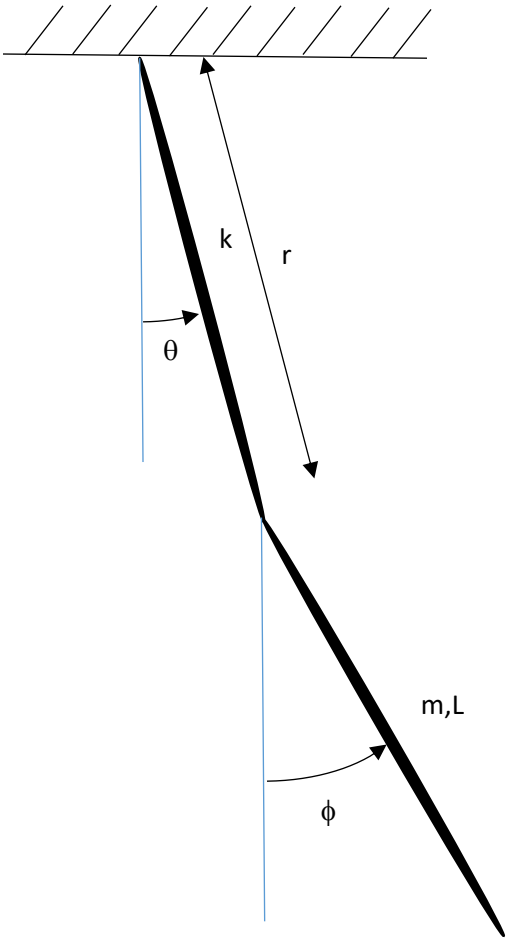
40 Midterm Exam Points



There is a rigid-body pendulum connected to the fixed pin with a linear spring with spring coefficient k = 25 N/m and unstretched length 0.5 m. The mass of the bar is m = 1 kg, with length, L = 1 m.

1. Determine the system EOMs via the Lagrangian method.
2. Integrate the EOMs for the system using various initial conditions to show the different styles of motion that the system exhibits. All systems start at rest with spring unstretched.

a. Initial positions: $\theta_o = 0rad,\ \phi_o = 0rad$

Plot the response for 10 seconds.

b. Initial positions: $\theta_o = \frac{\pi}{18}rad, \phi_o = \frac{\pi}{9}rad$

Plot the response for 10 seconds.

c. Initial positions: $\theta_o = \frac{\pi}{6}rad,\ \phi_o = \frac{\pi}{3}rad$

3. Plot the total energy vs. time for all 3 cases
4. Repeat 2. and 3. using a 'RelTol' of 1e-6 and 'AbsTol' 1e-9 for the ode45 integration tolerances.