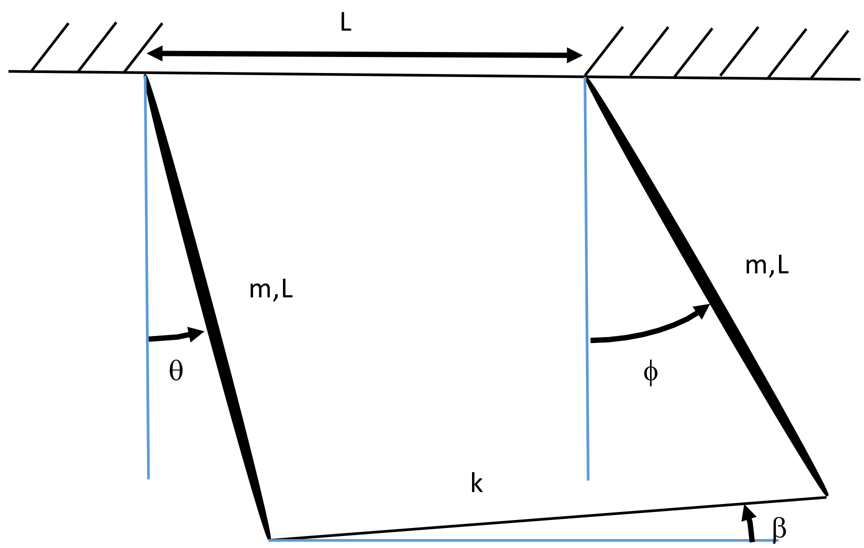
There is a rigid-body pendulum system with each having equal mass, m = 0.25 kg, and length, L = 0.5 m. A linear spring, with spring coefficient k = 25 N/m and unstretched length L, is attached at the ends of the two bars as shown.



1. Determine the 6 equation / 6 unknown system to solve for the system EOMs.
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
   a. Initial positions: $\theta_o = \frac{\pi}{12} rad,\ \phi_o = \frac{\pi}{12} rad$

      Plot the response for 10 seconds.
   b. Initial positions: $\theta_o = -\frac{\pi}{12} rad, \phi_o = \frac{\pi}{12} rad$

      Plot the response for 10 seconds.
   c. Initial positions: $\theta_o = \frac{\pi}{36} rad,\ \phi_o = \frac{\pi}{12} rad$

      Plot the response for 10 seconds.
3. Linearize the EOMs by assuming small angular positions and velocities, i.e., sin(x) = x, cos(x) = 1, and any angular position or velocity times any other angular position or velocity is negligible.

$$\begin{bmatrix} \ddot{\theta} \\ \ddot{\phi} \end{bmatrix} = [A] \begin{bmatrix} \theta \\ \phi \end{bmatrix}$$

   What is the [A] matrix?
4. By calculating the eigenvalues and eigenvectors of [A], what are the 2 natural frequencies for this system and their associated eigenvectors?

5. Using the previous information, solve for the analytical solution to the linearized EOMs and plot these analytical solutions for the 3 sets of initial conditions with the numerical solutions from Part 2.