Contents


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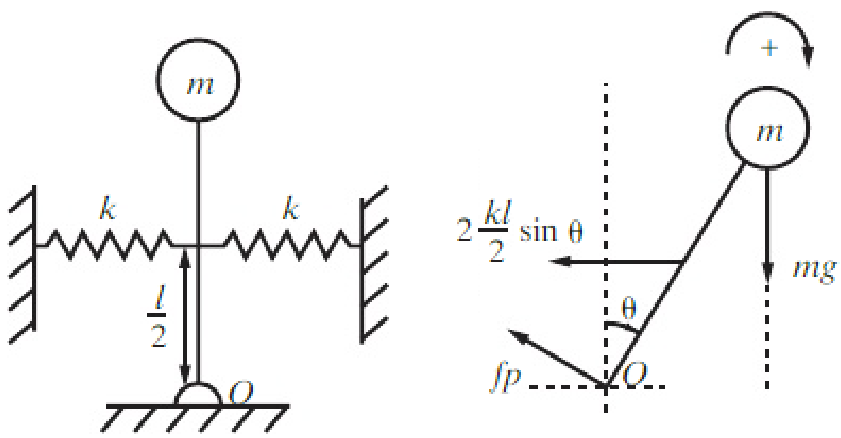
% Joel Lubinitsky - 02/18/15
% MAE 321 - HW 5.2

clear all
close all
clc
```

Problem 2:

Consider the inverted pendulum of figure 1.40 in the book. Assume that one dashpot (of damping rate c) is installed in-line with the two springs. How does this affect the stability properties of the pendulum? Your answer should include any additional restrictions on the system parameters to ensure stability.



Find: Stability of system, Requirements for stability

Calculations

Sum of moments around pivot

$$ml^2\ddot{\theta} = -[\frac{kl^2}{2}\sin\theta + \frac{cl^2}{4}\sin\dot{\theta}]\cos\theta + mgl\sin\theta$$

$$ml^2\ddot{\theta} + [\frac{kl^2}{2}\sin\theta + \frac{cl^2}{4}\sin\dot{\theta}]\cos\theta - mgl\sin\theta = 0$$

With small angle approximation,

$$ml^2\ddot{\theta} + \frac{cl^2}{4}\dot{\theta} + \frac{kl^2}{2}\theta - mgl\theta = 0$$

$kl - 2mg < 0$, so system is still unstable by divergence.

No forcing term dependent on velocity, so damper does not affect stability of system.

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