Math 531 Project 1

Due Tuesday, September 2

(1a) Problem 1.1a. Note that $q_1 = x_1, q_2 = x_2$ and that the kinetic and potential energies are given by

$$T(q, \dot{q}) = \frac{1}{2}\left[M_1 \dot{x}_1^2 + M_2 \dot{x}_2^2\right]$$
$$W(q) = \frac{1}{2}\left[K_1 x_1^2 + K(x_1 - x_2)^2 + K_2 x_2^2\right].$$

(b) Consider the two-mass system derived in class with the parameter values $M_1 = 1, M_2 = 1, k_1 = 10$, $k_2 = 5, k = 2, c_1 = 1, c_2 = 2, c = 1$ with measurements consisting of the velocity of Mass 2. A common way to analyze the dynamics of a system is to consider its response to a step input. This can be easily simulated in matlab by setting up the system matrices and using the `step` command. Let's consider the force input to be on Mass 1. Set up the matrices A, B and C and take $D = [0]$. The command to simulate the step response is `step(A,B,C,D)`. You can obtain a grid using the Matlab command `grid`. Print out and discuss your results. Now obtain the step response with no damping $c_1 = c_2 = c$ and discuss your results. Finally, discuss the behavior if you increase either of the masses or decrease the stiffnesses.

(2) Problem 1.3. Do not use examples from class.

(3) Problem 1.20

(4) Problem 1.28

(5) Problem 1.33. Use the matlab function `ode45.m` to integrate the systems.