**Coupled Oscillations Homework**

**Due on Friday evening, 2nd Rabi-II**

**Question #1:**

A system consists of two-pendula of equal mass and equal length oscillating in a vertical plane. The pendula are connected by a spring that is unstretched when the masses are in the vertical positions. Consider small oscillations only.

* From symmetry arguments discuss the expected normal modes for the system). Is there anything to be said about the eigenfrequencies?
* Formally (i.e. mathematically) determine the normal frequencies and normal modes of oscillation.
* Use a computer code to find the results above
* Find the general motion of the masses as a function of time if initially the two masses were struck (from rest at equilibrium position) in opposite directions with an impulse of magnitude I.

Hint: read the textbook

**Question-2:**

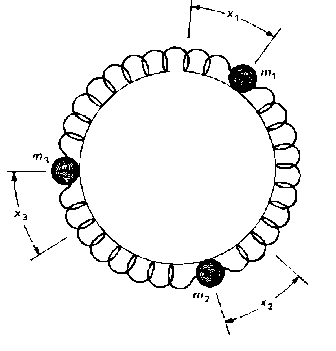
Masses m and M are connected with a spring of stiffness . Collinearly, mass m is connected to a wall with a spring of stiffness k. Similarly, mass M is connected to a wall by a spring of stiffness k. See the figure.

It is given that M = 4 m, and  = 2/3 k.

1. Find the frequencies of free vibrations
2. What are the normal coordinates
3. Assume the systems starts with mass m displaced by (**A**) and speed zero while mass M has no displacement, and speed zero. Find the consequent position of the two masses.

Hint: you will probably need to get assistance from Mathematica, as discussed in class.

**Question-3:**

Three particles of the *same mass* (m = 120 grams) are constrained to move in a common circular path (see figure). They are connected by three *identical springs* each with stiffness 25 N/m.

* Find the general motion of the three masses.
* Assume it is noticed that the displacements of the first and third particles are of the same amplitude but opposite phase (i.e. x1 = -x3) while the x2 is continuously stationary. Find the frequency of vibration of the first particle.