PH1140 B08 Written Homework Three – Coupled Oscillators Due November 19, 2008

1. Two identical pendulums A and B are connected by a spring of force constant $k = 1.017\ N/m$. Each pendulum has a length of $L = 0.4\ m$ and a mass of $m = 0.23\ kg$. Neglect the mass of the spring, and use gravitational acceleration $g = 9.8 m/s^2$.

a) What are the periods of the two normal oscillation modes of the coupled pendulums?

b) For the initial conditions $x_A = 0.02m,\ x_B = 0.02m,\ v_A = 0,\ v_B = 0$, determine the amplitudes and initial phases of the pendulum displacements $x_A(t)$ and $x_B(t)$. Hint: only one normal mode is involved.

c) For the initial conditions $x_A = 0,\ x_B = 0,\ v_A = 0.173 m/s,\ v_B = -0.173\ m/s$, determine the amplitudes and initial phases of the pendulum displacements $x_A(t)$ and $x_B(t)$. Hint: only one normal mode is involved.

d) Starting with both pendulums in their equilibrium positions, one pendulum is given an initial displacement and then released. What is the time interval T_{maxima} between successive maximum amplitudes of pendulum A? Hint: try using the coupled pendulum applet to study the motion, and consider the beat period as arising from the superposition of the two normal modes.

e) Sketch $x_A(t)$ and $x_B(t)$ over the time interval $T_{maxim\ a}$.