Physics 821: Problem Set 8

Due Thursday, December 3, 2009, at 11:59 P. M.

Note: this is only part of the problem set. There will also be a couple of problems based on chapter 8, and possibly another problem. I will send out the full set early next week.

1. GPS Chapter 6, problem 4 (exercise)

2. GPS, Chapter 6, problem 11 (exercise)

3. GPS, Chapter 6, problem 14 (exercise)

4. GPS, Chapter 6, problem 18 (exercise)

5. Consider a very long line of N masses, connected by springs of identical spring constant k, and with periodic boundary conditions. The masses are not identical, but are alternately M and m. The equilibrium spacing between adjacent masses is a.

   (a). Write down the Lagrangian for this system.

   (b). Hence, from Lagrange's equations, obtain the N coupled second-order equations of motion.

   (c). Assume solutions of the form $\eta_n = A\exp(2nika - i\omega t)$ for the masses M and $\eta_n = B\exp(2nika - i\omega t)$ for the masses m, and show that the frequencies $\omega^2(k)$ are solutions of a quadratic equation. Solve this quadratic equation to obtain the dispersion relation $\omega^2(k)$ and sketch the results. Over what range of k is it necessary to consider solutions?

6.