Physics 3344
Homework 11 — 8 Apr 2008
Due Tues, Apr 15

1. Read Marion 7.5 to 7.7 (Essence of Lagrangian Mechanics). Also, read the first half of the Feynman lecture on Least Action (posted).

   True/False: I read this material.

2. (Problem 7.8 in Taylor, on reserve) (a) Give the Lagrangian $L(x_1, x_2, \dot{x}_1, \dot{x}_2)$ for two particles of equal mass m confined to the x axis, and connected by a spring with $U = (k/2)(x_1 - x_2 - \ell)^2$. Here ℓ is the spring's unstretched length, where $U = 0$. Assume that particle 2 remains to the right of 1.

   (b) Rewrite L in terms of CM coordinates $X \equiv (x_1 + x_2)/2$ and $x \equiv x_1 - x_2 - \ell$. Derive and solve the Euler-Lagrange equations for $X(t)$ and $x(t)$. (The equations should look very familiar and be trivial to solve.)

3. Marion Ch 7, Problems 4, 11, 12

   (See my comments under News on our web page about problem 7.11.)

4. For the particle in a cone (example problem 7.4 in Marion 4th ed), one possible solution we found in lecture is circular motion (constant r) at constant angular velocity $\omega = \dot{\theta}$.

   (a) Use Newton's laws to rederive the connection between r and ω for this case.

   (b) Give the frequency for an orbit whose radius oscillates a small amount about a fixed r; that is, about a circular orbit.