PHYS 251 HONOURS CLASSICAL MECHANICS 2014

Readings and Homework Set 7

Readings: Chapter 7.

Problems, due Oct. 28 in class (Note: unusual day - I was asked to give extra time because of midterm stress):

1. Textbook, Exercise 6.28.

2. Textbook, Exercise 6.43.

3. Suppose a particle moves in space subject to a conservative potential $V(r)$ but is constrained to always move on a surface whose equation is $\sigma(r,t) = 0$ (Note the explicit time-dependence!). The instantaneous force of constraint is perpendicular to the surface. Show analytically that the energy of the particle is not conserved if the surface moves in time.

4. Consider two particles of masses m_1 and m_2. Let m_1 be confined to move on a circle of radius a in the $z = 0$ plane, centered at $x = y = 0$. Let m_2 be confined to move on a circle of radius b in the $z = c$ plane, also centered at $x = y = 0$. A massless spring of spring constant k is attached between the two particles.
a) Find the Lagrangian of the system.
b) Solve the problem using Lagrange multipliers and give a physical interpretation for each multiplier.

5. A particle of mass m is suspended by a massless string of length L. It hangs, without initial motion, in a gravitational field of strength g. It is struck by an impulsive horizontal blow, which introduces an angular velocity ω. If ω is small, the particle will oscillate about the initial position. For large values of ω it will rotate about its point of support. What is the critical value of ω (where the string becomes slack at some point in the motion)?

6. Textbook, Problem 7.16 (attempt only later in the week).