PHY 5246: Theoretical Dynamics, Fall 2011

September 23rd, 2011
Assignment # 4
(Graded problems are due Friday September 30th, 2011)

1   Graded problems

1. A spherical pendulum consists of a bob of mass m attached to a weightless, extensionless rod of length l. The end of the rod opposed to the bob pivots freely (in all directions) about some fixed point.

   (1.a) Set up the Lagrangian function in spherical coordinates and derive the equations of motion. How can you interpret the equation for ϕ, the angle of rotation about the vertical axis?

   (1.b) Discuss the limiting case $\phi = \phi_0$, i.e. ϕ =constant.

   (1.c) Discuss the case $\theta = \theta_0$, i.e. the case of a *conical pendulum* (θ is the angle with respect to the vertical). Which condition needs to be verified for the pendulum to move at $\theta = \theta_0$? Find the frequency of small oscillations about $\theta = \theta_0$.

2. A particle of mass m starts at rest on top of a smooth hemisphere of radius a. Find the force of constraint, and determine the angle at which the particle leaves the hemisphere.

3. Chapter 2, Problem 14 of your Textbook.

4. Chapter 2, Problem 21 of your Textbook.

2   Non-graded suggested problems

5. Chapter 2, Problem 2 of your Textbook.

6. Chapter 2, Problem 4 of your Textbook.