September 14, 1999

PHY 711 – Problem Set # 8

1. Consider the Lagrangian for the motion of a symmetric top under the acceleration of gravity:

$$L(\theta, \phi, \psi, \dot{\theta}, \dot{\phi}, \dot{\psi}) = \frac{1}{2} A \left(\dot{\phi}^2 \sin^2(\theta) + \dot{\theta}^2 \right) + \frac{1}{2} B \left(\dot{\phi} \cos(\theta) + \dot{\psi} \right)^2 - Mgh \cos(\theta),$$

   where A, B, M, g, and h are parameters related to the moments of inertia, the mass, the acceleration of gravity, and the location of the center of mass. The angles θ, ϕ, and ψ are called the "Euler angles" and are the generalized coordinates for this system. Identify the constants of the motion and find the Hamiltonian (in canonical form) for this system.

2. Consider a particle of mass m and charge q moving in a constant magnetic file $\mathbf{B} = B_0 \hat{\mathbf{z}}$ as in Problem Set #7. Starting from the Lagrangian for this system, find the Hamiltonian (in canonical form).