Classical Mechanics (PH211 + PH403)

Tutorial VII

1. Solve the following problems from Goldstein(2^{nd} Edition, Pages 238-239): Question No.s: **2, 3, 6, 7**

2. A rigid body of mass M and having principal moments, I_1, I_2, I_3 about its centre of mass is suspended by a point on its x_1 axis. The body is set to oscillatory motion in plane perpendicular to the x_3 axis. Find the period of small angle oscillations of the body using Lagrangian method. Take l as the distance of the point of suspension from the centre of mass.

3. Derive the Euler-Lagrange equations for a solid cylinder of mass M and radius a rolling inside a static hollow cylinder of radius R under gravity ($R > a$). Find the frequency of small oscillations of the centre of mass of the small cylinder.

4. A thin homogeneous disk of mass M and radius r is pivoted to a vertical pole by a light rod of length l passing through the center C of the disk (see figure on right). The disk rolls on the horizontal surface with out slipping such that its center C traces a circle of radius l about the pole at a frequency Ω. The motion of the disk about the pole is in the counter clock-wise direction. Find the kinetic energy of the system. Express the instantaneous angular velocity of the system in cylindrical coordinates.