Homework set #2  due 9-17-2007

1a) Write down the lagrangian of a falling particle

1b) Assume that you know that time it takes to fall by a distance $y_0$ is $t_0 = \sqrt{\frac{2y_0}{g}}$. Assume that the motion is given by $y = at + \frac{1}{2} b t^2$. Determine the constants $a$ and $b$ by minimizing the action $S = \int_0^{t_0} L \, dt$

2) Using symmetries find a conserved quantity of the lagrangian $(\dot{x} = (x_1, x_2, x_3))$

\[
L = \frac{1}{2} m (\dot{x}^2) - U_0 x_1 \sin \frac{2 \pi x_3}{R} - U_0 x_2 \cos \frac{2 \pi x_3}{R}
\]

Find a generalized coordinate whose generalizer momentum is conserved.

3) Consider a particle that can move freely along a circle that rotates with angular velocity $\Omega$

a) Write down the lagrangian

b) Write down the eqs. of motion and determine the equilibrium position of the particle

c) What is the condition for stability of the equilibrium position

4) A rod attached to $m$ at one end and a string at the other, a mass $m$ at the end of the string. a) Write down the lagrangian