Physics 342, Homework 5

In all of these, be systematic. I want:

-coordinates defined

-kinetic energy defined

-potential energy defined

-the Lagrangian written out

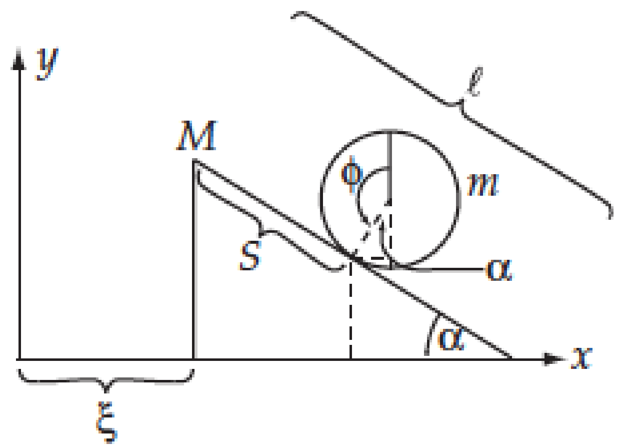
-Lagrange's equations in each coordinate

-solutions

I'll grade harshly if this prescription isn't followed

1: 7-6 Hint - The hoop has kinetic energy $\frac{1}{2}I\dot{\phi}^2$. The wedge also has kinetic energy. See the figure below. Take the center of the hoop as the generalized coordinates. Also, look at what pieces are changeable and what are not, example, R and l are fixed. You can also relate S and ϕ.

For this problem decouple the two equations and present the result for $\ddot{S}$ and $\ddot{\varepsilon}$. Interpret your answer



2: A long, straight, frictionless wire is attached to the z axis a distance h above the origin. This wire rotates at a constant angular velocity ω about the z axis. A bead of mass m is threaded onto the wire such that it can move up and down it. The wire makes a constant angle α with the z axis. Denote the length along the wire that the mass is as r. Essentially α and $\omega \times t$ takes the place of θ & ϕ in the spherical coordinate system. Make sure you reduce the form for kinetic energy to something I will check. It get's down to two terms.

A) Set up the Lagrangian for this system. B) Write out Lagrange's equations. C) Determine the motion of the particle in time - essentially r(t) where r is the distance along the wire from the z axis. Ask me if you fail to understand the geometry and I'll draw it for you.

For part C, remember, this is a non-homogenous second order linear differential equation. First solve for the homogenous portion then solve for the particular solution using something like the method of undetermined coefficients. Pick up your differential equations book if you need to.

3: 7-15 Hint - b is the unextended length, l is the extension or contraction it can be in either direction. Construct $d\vec{S} = d(l + b)\hat{r} + (l + b)d\theta\hat{\theta}$. Also, put the origin of your spring mass system at (0,0) so y is negative. remember $l = l(t)$ in the radial direction. Using the solutions manual for this book will show me you don't understand how to do these problems. Also, don't forget where explicit time dependence comes in.