Assignment 5   Due: Friday, Oct. 9

33.331

For each problem, explicitly write the Lagrangian in terms of your generalized coordinate(s). Then use the Lagrangian to find equations of motion. Don't try to solve them, except in problem 7.10.

1) Problem 7.4 of the text.
From you equations of motion, show whether or not angular momentum is conserved.
Of course energy is conserved... it's a conservative force. To *explicitly* show conservation of energy, they want you to evaluate $\frac{d}{dt}(T + U)$. you may first want to eliminate $\dot{\theta}$ from T by making use of a conserved quantity.

2) Problem 7.5 of the text. Consider only motion in the plane (and the corresponding angular momentum). Explain why the angular momentum is or is not conserved.

3) Problem 7.6 of the text.
The moment of inertia of a hoop (about its center) is mR^2. As you'll see later (but must assume here), the energy of a rotating, translating object is $\frac{1}{2}mv_{cm}^2 + \frac{1}{2}I\omega^2$ where v_{cm} is the speed of its center-of-mass and ω and I are taken about the center-of-mass. In this case, the center-of-mass of the hoop is simply the center of the hoop. You are asked to find "integrals of the motion" which means "conserved quantities". It's sufficient to find one conserved quantity (but you must find it from Lagrange's equations).

4) Problem 7.10 of the text. The answer in the back of the book is not very complete, but inspires hyperbolic trig substitutions.

5) Problem 7.14 of the text.
You may assume the pendulum swings only it the x-y plane, where y is upwards. (Don't worry about whether the support is massless or massive.. it moves with constant acceleration.)