Physics 106A: Classical Mechanics
Homework 3: Lagrangian Formulation of Mechanics

DUE: Thursday, October 19 2000

Remember: Late homework will be granted 50% credit UNLESS PRIOR ARRANGEMENTS ARE MADE WITH ME OR A TA. If you have an extension, please indicate who granted it clearly on the top of the paper.

Reading Assignment: Hand and Finch Chapter 1 & 2 (Recommended), Goldstein 2.4-2.6 (supplemental)

1. (*Practice solving problems using the Lagrange formulation.*) Hand and Finch Chapter 1, Problem 18.

2. (*More practice solving problems using the Lagrangian – Lagrange multipliers as extra credit)*

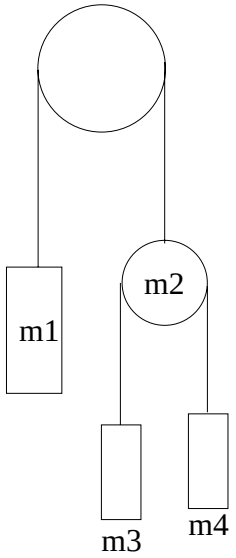
The sketch shows one version of a Double Atwood machine. A string of length a passes over a light, fixed pulley which supports a mass m_1 on one end and a pulley of mass m_2 and negligible moment of inertia on the other. Over the second pulley passes a string of length b supporting a mass m_3 on one end and a mass m_4 on the other.

A. Write down the Lagrangian for this system. How many degrees of freedom are there?

B. Determine the equations of motion.

C. From the EOM, find the condition on m_1 for it to remain in equilibrium. This should be expressible in terms of m_2, m_3 and m_4.

D. (extra credit) Set up the problem using Lagrange multipliers and find the tensions in the strings.



3. (*The double pendulum - an example of chaotic motion*) Consider the full non-linear equations that we derived in class for the double pendulum. Write a computer program, using whatever software you like, to solve them numerically. Explore solutions (graphically) for large amplitude

motion. Are they always periodic? If you change the initial conditions slightly, how does the resulting motion change?

You may work with a partner on this problem. Turn in a copy of the code that you used to generate the solution with your homework set, along with graphical output showing your results.