2.032 DYNAMICS Fall 2004

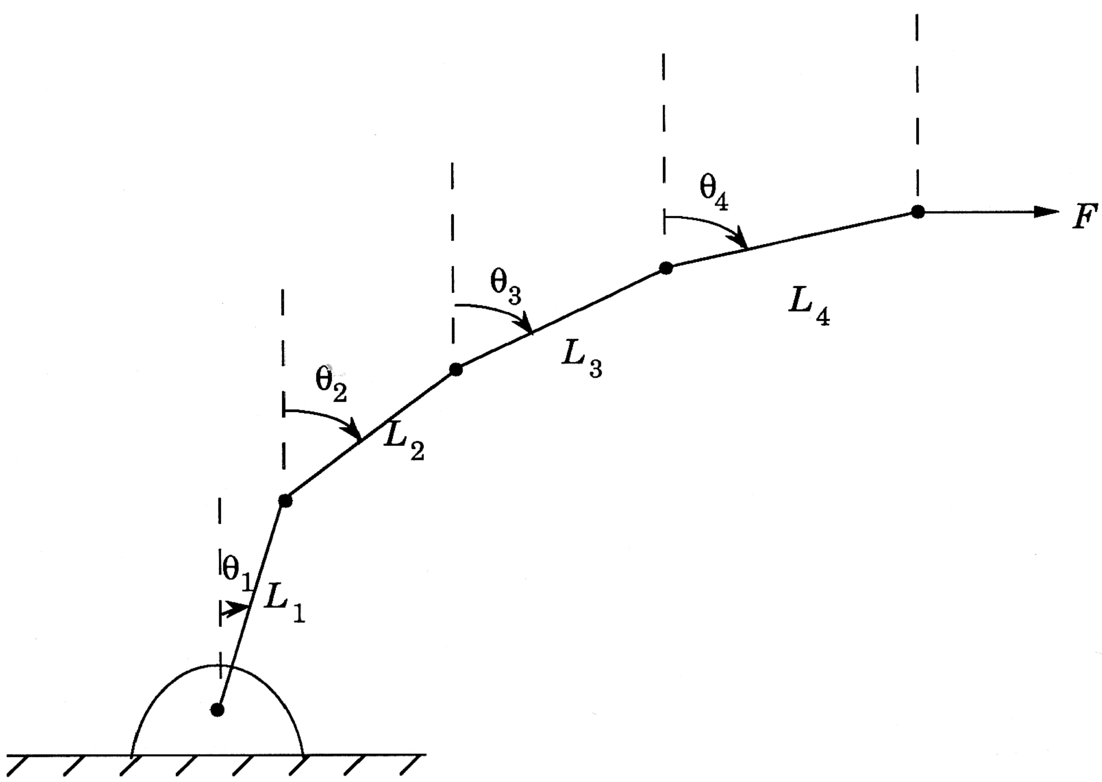
Problem Set No. 7

Out: Wednesday, November 3, 2004

Due: Wednesday, November 10, 2004 *at the beginning of class*

Problem 1

The force F acts horizontally at the end of the four-member linkage shown below. The linkage is described by the generalized coordinates $\xi_1 = \theta_1,\ \xi_2 = \theta_2,\ \xi_3 = \theta_3,\ \xi_4 = \theta_4$. Find the generalized forces $\Xi_1,\ \Xi_2$ conjugate to the generalized coordinates $\xi_1,\ \xi_2$ and due to the force F. You may *not* assume that θ_1, θ_2, θ_3, θ_4 are small angles.

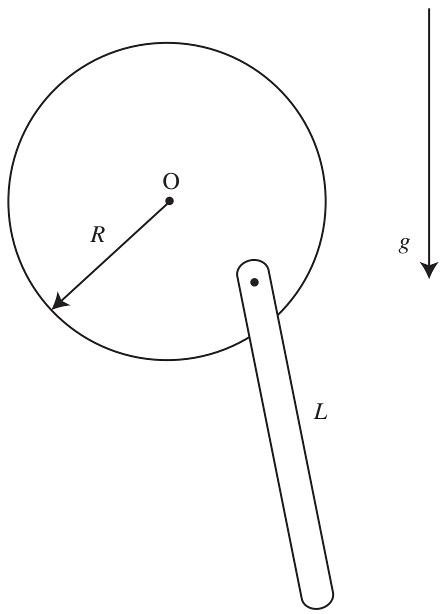


Problem 2

A pendulum consists of a rod of length L, mass m, and centroidal moment of inertia $\frac{1}{12}mL^2$ with a frictionless pivot at one end. The pendulum is suspended from a flywheel of radius R and mass M which can rotate about the fixed point O, as shown below.

(a) Select a complete and independent set of generalized coordinates. (Please define these coordinates *clearly*.)

(b) Derive the Lagrangian equations of motion without making any approximations (small angles, etc.).



Problem 3

Consider a bead of mass m sliding without friction on a rotating ring with radius r and negligible mass, as shown in the figure. The ring rotates about the vertical axis with constant angular velocity Ω. Derive the equation of motion of the bead using D'Alembert's principle.