Problem Set No. 3

Out: Wednesday, September 29, 2004

Due: Wednesday, October 6, 2004 at the beginning of class

Problem 1

A pendulum consists of a rod of length L with a frictionless pivot at one end. The pendulum is suspended from a . ywheel of radius R which rotates with . xed angular velocity ω, as shown below.

   (a) Determine the angular velocity of the rod in terms of ω and the generalized coordinate θ indicated in the sketch.
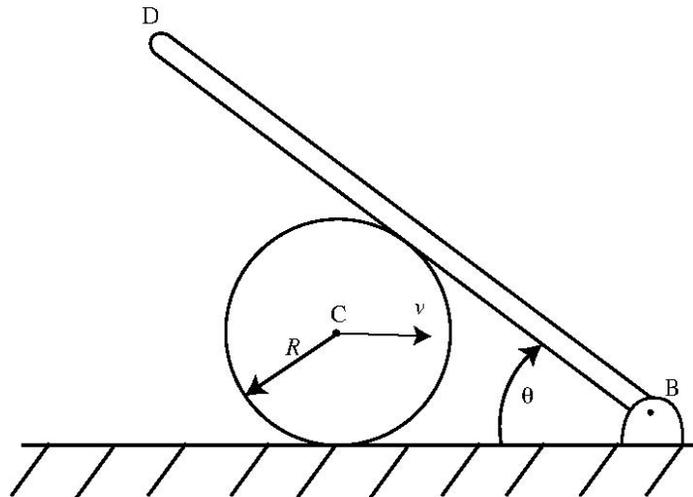
   (b) Calculate the velocity of the mid point C of the rod.
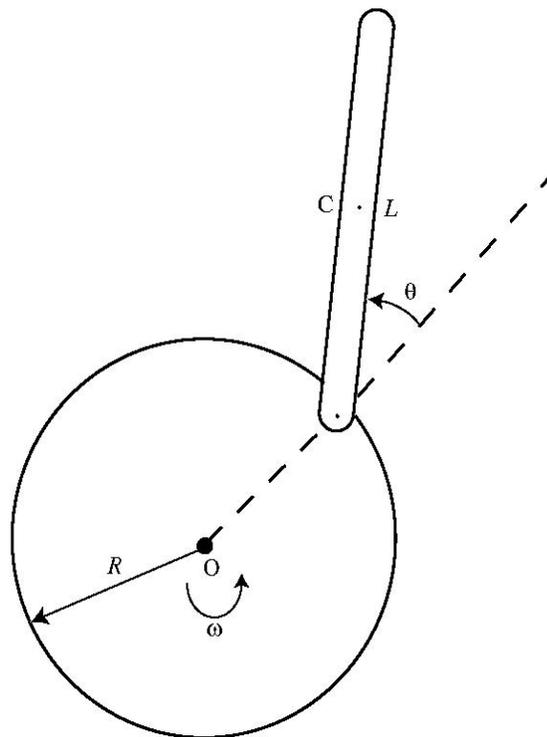
Problem 2 (adapted from Doctoral Qualifying Exam 2002)

In the system sketched below, the rigid cylinder of radius R is moving to the right such that its center C has velocity v. There is no slipping between the cylinder and the bar BD, but there is slipping between the cylinder and the ground. In the position shown,

(a) Determine the angular velocity of the bar BD.
(b) Determine the velocity of the cylinder at the point where it contacts the ground.

Problem 3

Consider the Cardan drive shown in the figure below. Determine the outgoing angular velocity ω_2 in terms of the angular velocity ω_1, and angles α and ψ. Note that angular velocity $\dot{\gamma}$ is perpendicular to both $\boldsymbol{\omega_2}$ and $\boldsymbol{\dot{\varphi}}$.

Problem 4

Consider the rocking chair problem discussed earlier in the class. Plot qualitatively the trajectories in the phase plane.