Problem 1

A pendulum consists of a rod of length $L$ with a frictionless pivot at one end. The pendulum is suspended from a flywheel of radius $R$ which rotates with fixed angular velocity $\omega$, as shown below.

(a) Determine the angular velocity of the rod in terms of $\omega$ and the generalized coordinate $\theta$ indicated in the sketch

(b) Calculate the velocity of the mid point C of the rod
Problem 2

A ring of radius $R$ is pivoted without friction at O. A disk of radius $r$ rolls without slipping inside the ring, as shown below. Determine the angular velocities of the ring and the disk in terms of the generalized coordinates $\theta$, $\phi$ indicated.
Problem 3  (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 4  (adapted from Ginsberg, 3-22)

The disk rotates at $\omega_1$ about its axis, and the rotation rate of the forked shaft is $\omega_2$. Both rates are constant. Determine the velocity and acceleration of an arbitrarily selected point B on the perimeter. Describe the results in terms of components relative to the $xyz$ axes in the sketch.