Physics 172 - Recitation 10 (Spring 2012)

Purpose: The purpose of this recitation is to allow you to gain further experience working with Multiparticle systems and rotational kinetic energy.

Readings: Sections 9.1-9.4

General Instructions:
   • Identify your system
   • State which objects are interacting with the system
   • State the fundamental principle(s) you use to solve the problems
   • Draw an appropriate diagram labeling key features of the problem
   • State the approximations and simplifying assumptions you use.

Note to Student: You may be finding problems more challenging, since you have to apply more than one fundamental principle or consider more than one system to construct the equations you need to solve them. Remember, it pays to use a systematic approach to solve more complicated problems like these. As you plan your problem solution, think about how what you are asked to determine can be related to what you know by applying fundamental principles and definitions to various systems. This will help you to build the equations you need to solve the problem.

Problem 1: Consider a bicycle wheel with a rim of mass M and an axle of mass m. The masses of the wheel's spokes are so small that we will neglect them.
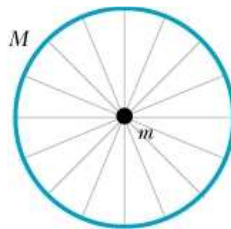
   Initially, the wheel is resting on a horizontal surface, and you hold its axle, a hand on each side of the wheel, so that it doesn't tip over. At time $t = 0$ s you exert a horizontal force of magnitude F on the axle so that the wheel begins to roll without slipping.

a) How does the speed of the wheel's rim relative to the wheel's center of mass compare to the speed of its hub when the wheel is rolling at speed V_{CM} without slipping? What is the wheel's rotational energy when it is rolling that way? What is its total kinetic energy? **[Checkpoint 1]**

b) When you have pushed the wheel forward a distance d what is its speed? **[Checkpoint 2]**

c) What is the magnitude of the friction force that the surface on which the wheel rolls exerts on the wheel while you are pushing it? **[Checkpoint 3]**