

## **Rotation and Translation Challenge Problems**

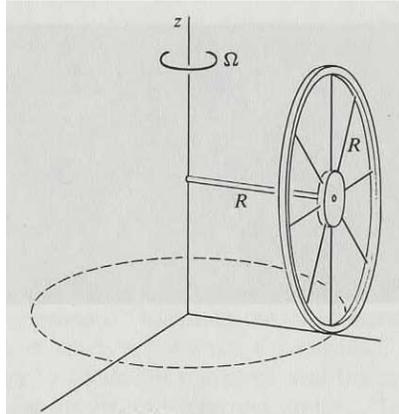
### **Problem 1: Frictional forces on bicycle wheels**

You are riding your bike along a flat country road. What are the directions and relative magnitudes of the frictional forces on the front and rear tires in the following situations:

- a) you are accelerating;
- b) you are pedaling along at a steady pace;
- c) you are braking. Both the brake and the pedals work on the rear wheel; there is no brake on the front wheel.

**Problem 2:**

A thin hoop of mass  $m$  and radius  $R$  rolls without slipping about the  $z$  axis. It is supported by an axle of length  $R$  through its center. The hoop circles around the  $z$  axis with angular speed  $\Omega$ . (Note: the moment of inertia of a hoop for an axis along a diameter is  $(1/2)mR^2$ .)



- What is the instantaneous angular velocity  $\vec{\omega}$  of the hoop? Specify the direction and magnitude.
- What is the angular momentum  $\vec{L}$  of the hoop about a point where the axle meets the  $z$  axis? Is  $\vec{L}$  parallel to  $\vec{\omega}$ ?

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## 8.01SC Physics I: Classical Mechanics

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