Recitation Problems for Week 11, Tuesday

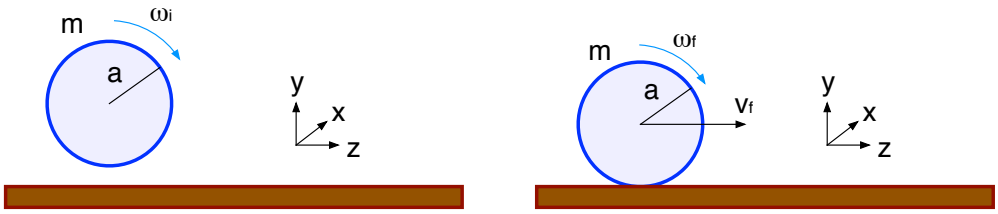

Figure 1: A hoop that is rolling and sliding across a rough surface. The left-hand picture shows the hoop the instant it is dropped on the ground. The right-hand picture shows the hoop after is rolling without slipping. See problem 7.S57.

7.S57. A hoop of mass m, radius a and moment of inertia about its center of $I = ma^2$ is initially spinning with angular velocity $\vec{\omega}_i = \omega_i \hat{x}$. It is dropped onto a rough floor, and at some later time it is observed to be rolling across the floor with speed $\vec{v}_f = v_f \hat{z}$ and rotating with angular velocity $\vec{\omega}_f = \omega_f \hat{x}$. It continues to roll with this final speed. This is shown in Figure 1. (a) How are ω_f and v_f related? (b) What are the forces that act on the hoop? (c) What is the torque about the center of the disk for each of the forces? (d) What is the torque about a point on the floor due to each of the forces? (e) What is the initial angular momentum of the disk about its center? (f) What is the initial angular momentum of the disk about a point on the floor? (g) What is ω_f in terms of ω_i? (h)What is the change in the internal energy of the hoop?

7.C17. A hollow sphere and a solid disk of the same mass, m, and radius, R, both roll without slipping down the same inclined plane. If the inline makes an angle of 30° with respect to the floor, how fast is each object moving after they have traveled a distance $10R$ down the plane?

7.S61. A negative muon can replace the eletron in a Hydrogen atom, where the mass of the $\mu^- \approx 210 m_e$. (a) What is the Bohr radius of the muonium ($\mu^- p$)? (b) What are the energies of the first 4 energy levels in muonium?