University of Alabama
Department of Physics and Astronomy

PH 105 LeClair Summer 2012

Problem Set 9

Instructions:

1. Answer all questions below. All questions have equal weight.
2. Due Fri 15 June 2012 at the start of lecture.
3. You may collaborate, but everyone must turn in their own work.

1. A cockroach with mass m rides on a disk of mass $6.00m$ and radius R. The disk rotates like a merry-go-round around its central axis at angular speed $\omega_i = 1.50\,\text{rad/s}$. The cockroach is initially at radius $r = 0.800R$, but then it crawls out to the rim of the disk. Treat the cockroach as a particle. What then is the angular speed?

2. A long uniform rod of length L and mass M is pivoted about a horizontal, frictionless pin through one end. The rod is released from rest in a vertical position. At the instant the rod is horizontal, find its angular speed. The moment of inertia of a solid rod about its center of mass is $I = \frac{1}{12}ML^2$.

3. A solid sphere of mass m and radius r rolls without slipping along the track shown below. It starts from rest with the lowest point of the sphere at a height h above the bottom of the loop of radius R, much larger than r. What is the minimum value of h (in terms of R) such that the sphere completes the loop? Do not ignore the rotational kinetic energy ... The moment of inertia for a solid sphere is $I = \frac{2}{5}mr^2$.