Physics 200 Name _____

December 7, 2004

Exam 4 – Angular Momentum, Harmonic Motion and Waves

This is a closed book examination. There is extra scratch paper available.

A general reminder about problem solving:

1. Draw a picture then create a simplified free body diagram with all forces
2. Write down what you know including coordinate frame
3. Write down what you don't know and/or want to know
4. List mathematical relationships
5. Simplify and solve
6. Check your answer – Is it reasonable? Are units correct?

- Show all work!

1. A solid cylinder pulley of mass m and radius r is held upright, and a number of circular turns of a light cord are wrapped around it within the groove (think yo-yo). The loose end of the cord is held vertically and the pulley is released so it falls straight downward, unwinding as it falls. Compute the pulley's linear acceleration (in terms of g) and tension in the cord (in terms of m and g) before the pulley reaches the end of the cord. The moment of inertia of a cylinder is $I = \frac{1}{2}mR^2$

2. A small mass, m, is tied to a string and swung in a horizontal plane. The string winds around a vertical rod as the mass revolves. Given that the initial speed and length are v_i and r_i, compute v_f when $r_f = r_i/10$.

3. Write an expression for the orbital angular momentum of a small artificial satellite of mass m in a circular flight-path of radius r about the Earth. What happens to angular momentum as the orbit increases?

4. A small mass is attached to the end of a long vertical string of length L. It is displaced through an angle θ and then swung so that the mass moves in a horizontal circle (this is "bob"). Show that if you looked at the resulting conical pendulum in the plane of motion (the horizontal plane), you would see the bob moving back and forth with a period given by $T = 2\pi\sqrt{\frac{L\cos\theta}{g}}$.

5. A transverse wave on a long beaded string is described in SI units by the function $y(x,t) = 0.02\sin(6.28x - 15t)$. If we have a detector at x = 0, what will be the speed of the bead at that location at a time t = 1.2 seconds?