Problem Set 10: Torque, Rotational Dynamics, Physical Pendulum, Angular Momentum

Design Engineering Challenge: "The Big Dig" 2.007 Contest
Paddle Spinning Strategies

For the Spring 2004 contest table ("The Big Dig", see http://pergatory.mit.edu/2.007) a spinning scoring paddle's maximum speed is a multiplier for your total score. Strategies to make the paddle spin include impact or constant acceleration…..

1. Given the paddle's moment of inertia is J (kg-m^2), how fast does it spin after an elastic collision with an object of mass m from a height h?
2. Does it make sense to try and add a constant force or impulse to aid gravity in accelerating the object onto the paddle? How much would be needed to make it worth your while
3. How would friction affect your calculations? In other words, is it an elastic or inelastic collision between the projectile and the paddle (and under what conditions?)
4. If you are thinking of dropping N balls one after another from a height h onto the paddle to try and spin it up to maximum speed, is their a maximum number of balls (does the system reach terminal velocity?)?
5. Given the time constraints of the contest, and assuming your motors are limited to 3 Watts of power, is it reasonable to try and spin the paddle up using motor power?
6. So, is it best to just carry a heavy object up and drop it onto the paddles, or is it best to drop the heavy object into the mass scoring bin, and instead accelerate a hockey ball onto the paddle wheel in order to spin it up?