Phy131 Sixth Homework Assignment
Due Wednesday March 2nd

Figures for the questions can be found after this link on my home page

Question 1.

Major league baseball pitcher can throw a basefall toward home plate at 90 miles/hr with a spin of 1800 revolutions per minute. The distance from the pitcher's mound to home plate is approximately 60 feet. How many revolutions does the baseball make on its way to home plate?

Question 2

Ed spins a "cake-walk" wheel at a carnival. The wheel has 16 numbers, $1 - 16$, equally spaced around it in numerical order clockwise. When the wheel stops, the number at the top is the winner and wins a cake. The initial angular velocity of the wheel is 30 radians/sec in the clockwise direction. The initial number at the top is 1. The wheel has an angular acceleration of -0.5 radians/sec^2. Find:

a) The time it takes for the wheel to stop.
b) What the winning number is.

Question 3

Sue owns a pick-up truck, which has a mass of 1000 kg. The front wheel and rear wheel are separated by a distance of 4 meters. The center of mass of the truck is 1 meter behind the front wheels. The truck has rear-wheel drive.

a) How much weight in Newtons do the front tires push down on the road with?
b) How much weight in Newtons do the back tires push down on the road with?
c) What is the maximum acceleration that Sue's truck can have if the coefficient of static friction is $\mu = 0.6$.

Question 4.

As a way to get more energy for human use, Grey wants to take energy away from the rotational energy of the earth. How much energy in Joules would be lost from the earth's rotational energy if the day were to be one second longer? Note: this way we all would be able to get one second more sleep per day. Take the mass of the earth

to be 5.98×10^{24} kg, and the radius to be 6.37×10^6 m.

Question 5.
   To swing the baseball bat faster, some players "choke-up" on the bat. Find the rotational inertia of a thin rod of length L and mass m about a point that is $L/4$ laway from one end. Express your answer in terms of L and m.

Question 6.
   Consider the set-up shown on the figures page. The pulley has a mass of m and a radius R. Assume that the pulley is a cylindrical disk. The coefficient of friction between the block and the table is μ.

a) What is the acceleration of the system? Express your answer in terms of g and μ.
b) What are the tensions T_1 and T_2? Express your answer in terms of m, g, and μ.

Question 7.
   A cylinder travels down the ramp and off the cliff as shown in the figure. The cylinder leaves the cliff traveling horizontally. If the cylinder were to **slide without friction and not rotate**, it would land a distance d_0 from the base of the cliff. If the cylinder **rolls down the ramp**, how far from the base of the cliff does it land? Express your answer in terms of d_0.

Question 8.
   Prove the parallel axis theorum for a rigid body:

$$I = Md^2 + I_{cm} \tag{1}$$

where I is the rotational inertial about an axis, M is the total mass of the rigid body, d is the perpendicular distance from the axis to the center of mass, and I_{cm} is the rotational inertia about the center of mass parallel to the axis.