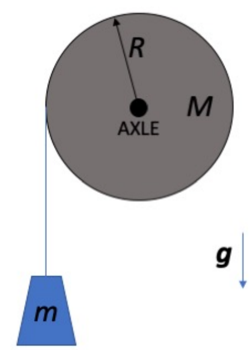
Chapter 9-10 Written Homework Problems
DUE: March 31th at the beginning of class
SHOW ALL WORK FOR FULL CREDIT

1. Taking the earth's orbit about the sun to be circular, *(a)* what is its average linear speed and angular velocity. Assume the earth can be treated as a particle. *(b)* What is its centripetal acceleration with respect to the sun? *(c)* What is the ratio of the centripetal acceleration of a point on the earth's equator relative to the earth to the centripetal acceleration of the earth relative to the sun?

2. A bicycle traveling at 20 mph has wheels that are 27" in diameter. *(a)* What is the angular speed of the wheels about their respective axles? *(b)* What is the angular acceleration of the wheels if they are brought to a rest in 15 revolutions? *(c)* How far does the bike travel while braking? Give all answers in SI units.

3. A top fuel dragster develops 9000 hp at 10,000 rpm. What torque (in foot-pounds) does the engine deliver under these conditions?

4. A disk rotates about a frictionless axle as a mass m, attached to the disk by a light cord, falls under the action of gravity, see figure. Take R to be the disk radius and M its mass. *(a)* What is the angular acceleration of the disk? *(b)* What is the tangential acceleration of a point on the rim of the disk? If the disks starts from rest with $m = 1$ kg, $M = 500$ g, and $R = 50$ cm, *(c)* what is the work done by the torque applied to the disk over the first 2.0 seconds and *(d)* what is the change in rotational kinetic energy of the disk?



5. For the demonstration we did in class in which your colleague inverted the spinning wheel while standing on the platform, take the rotational inertia of the bike wheel to be 0.30 kg-m^2 and the rotational inertia of the frictionless chair upon which they sat as 0.25 kg-m^2. Assume the bike wheel to be spinning at 125 rpm and after turning it upside down your colleague and the chair rotate at 70 rpm, (a) what is the mass of your colleague assuming they can be approximated as a cylinder which is 30 cm in diameter? (b) What is the work your colleague did in turning the bike wheel upside down?

6. Consider a pendulum made from a rod of length ℓ and mass M hanging from a pivot as shown in the Figure. This is called a 'physical' pendulum. A physical pendulum refers generally to a rigid body of arbitrary shape that is free to swing in a plane. A piece of clay having a mass m and a horizontal velocity v strikes the rod at $\ell/2$ and sticks. What is the minimum speed of the clay necessary such that the rod swings up and over the pivot point? Express you answer in term of M, m, g, and ℓ.