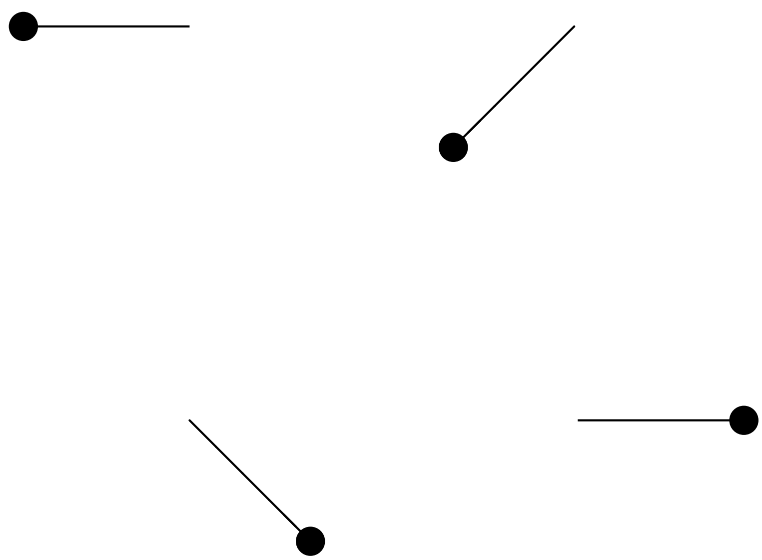
Assignment 4; Phys 185 Name ______________

1. (30 points) Why are brakes on a bicycle applied to the rim of a wheel and not on the axle? Model the bicycle wheel as a disk. Apply the same normal force with the brake pad, with the brake pad placed either near the rim or near the axle. The materials that come into contact are the same in both cases. In which case would the wheel come to rest faster? Construct a full argument, using equations as appropriate.

2. (30 points) You have a car traveling down the highway at constant speed v. Its wheels have a radius of 0.29 m and have 12 identical-looking spokes each, and they are rolling without slipping. You then film this car at a frame rate of 24 frames per second. Calculate the minimum speed v at which the tires will appear not to be rotating at all on film—so that at slightly smaller speeds the car wheels will appear to be rotating in the wrong direction. Express this speed both in m/s and in miles per hour.

3. (40 points) You have a pendulum consisting of a mass m hanging at the end of a string with length l. You attach the loose end of the string to the ceiling. Then you start with the string stretched out horizontally, making an angle of $\theta = 0$ with the horizontal. You let the pendulum swing, and since there is no friction or air resistance, the pendulum will swing back and forth with period T, ending up at its initial position after a time T elapses.

(a) Find the torque on the swinging mass, as a function of m, g, l, and θ. Give torque values for the angles shown: $\theta = 0°, 45°, 90°, 135°, 180°$.



(b) Make rough sketches of the angular acceleration, angular velocity, and angle versus time graphs. You can't find these exactly without solving some nasty differential equations, but you can produce qualitative graphs. Pay particular attention to the times $0, T/4, T/2, 3T/4, T$; indicating whether any of your quantities are 0, a maximum, or a minimum value at those times.