PHYSICS 121 WORKSHEET 15 11/8/2017

NAME: SECTION:

1. Write down the equations of motion for a rotating object. Write down the definitions of torque, angular momentum, angular velocity, angular acceleration, and angular kinetic energy. What is the expressions for the conservation of angular momentum? What is the expression for conservation of kinetic energy of an object that is both rotating and translating?

2. A ball with mass M radius R with moment of inertia $I = \frac{2}{5}MR^2$, starting from rest at the top of a hill of height h, begins to roll down. What is the angular momentum of the ball when it reaches the bottom of the hill? Answer in terms of M, R, g, and h. *Hint:* apply conservation of energy, taking into account the potential, rotational, and translation energy of the ball at the top and bottom of the hill. Then use the definitions of angular velocity and angular momentum.

3. A disk of mass M and radius R has moment of inertia I_0. A particle of mass m is then attached to the rim of the disk, a distance R from its center. The disk-particle system then begins to rotate with angular velocity w. If the particle is removed from the rim of the disk, what is the new angular velocity w' in terms of given variables? *Hint:* Apply the parallel axis theorem to find the net moment of inertia when the particle is on the rim of the disk, then apply conservation of angular momentum for when the particle is on and off the disk.

4. A disk of mass M and radius R having moment of inertia I is initially at rest. A ball of putty of mass m is thrown with velocity v perpendicular to the radius of the disk (tangential to its rim) such that the ball sticks to the rim of the disk upon collision. What is angular frequency w of the disk after the ball sticks to it, in terms of the given variables? *Hint:* Apply the definition of angular momentum in terms of v, R, and m, then apply conservation of angular momentum and the parallel axis theorem.