Lab 5

Physics I

College of the Atlantic

General Instructions:

1. Goal for this lab: Explore rotational energy
2. Work in groups of two or three, but preferably two.
3. There is nothing that you need to hand in, but at least one of your group members should record your work. Please check with me before you leave the lab, so I can look over your work and ask a few questions before you leave.
4. Please work slowly and carefully. You should have plenty of time, so there's no need to rush through calculations.

Rotational Energy

1. Suppose you roll a hoop and a solid disk down an incline. The hoop and the disk have the same mass and radius. Which will roll faster? Why? Discuss and debate, make a hypothesis, and then test it out.

2. In class on Monday we developed some results related to rotational kinetic energy:

   - $K^{\text{rot}} = \frac{1}{2} I\omega^2$.
   - I is the moment of inertia—a property of an object that is related to how difficult it is to make it rotate. You can think of it as "rotational mass".
   - The total kinetic energy of an object is equal to its rotational and translational kinetic energies: $K = K^{\text{rot}} + K^{\text{CM}}$.
   - $v_{\text{CM}} = R\omega$, if the objects rolls without slipping.

3. Using conversation of energy determine a formula for the velocity of a solid disk that rolls down an incline whose height is h. Your answer will have an h in it.

4. Repeat this calculation but with a hollow disk—i.e. a hoop. According to your calculations, which has a larger final velocity, the hoop or the disk? Discuss why your answer makes sense.

5. Calculate the ratio of final velocities.

6. Now do the experiment. Roll the hoop and disk down an incline, taking a video of the hoop and disk as they roll across the level floor after having rolled down the incline.

7. Use the video analysis tool in LoggerPro to determine the speed of the hoop and disk. Then calculate the ratio of the speeds. How do they compare with the expected ratio that you calculated?