Conservation of Gravitational Potential Energy and Translational and Rotational Kinetic Energy - 03-22-02

Name ____________________________ _____

Purpose: To investigate the conversion of gravitational potential into translational kinetic energy and rotational kinetic energy. The apparatus used will be very similar to that used to investigate rotational inertia.

Theory: A stationary mass suspended from a string has a certain amount of gravitational potential energy at the start. It is released. As it falls, the gravitational potential energy is converted to translational kinetic energy. Also, it pulls down on the string, which is wrapped around a step pulley, which is attached to a solid metal disk. As the disk rotates, it acquires rotational kinetic energy.

Procedure:

1. Find the mass of the falling plastic PASCO hanger with 20 gram mass and RECORD as $m_{hanging}$.
2. RECORD the radius of the pulley, 2.39 cm, as r_{pulley}.
3. Open the Data Studio file named ‘rotkin’.
4. Carefully wind the string onto the largest step pulley by rotating the metal disk clockwise as viewed from above. Watch the string the whole time you wind to make sure it stays on the largest pulley.
5. When it is near the slotted pulley, make sure the hanging mass is not swinging back and forth. Click on ‘start’, wait until you see data being recorded, and then carefully but quickly release the mass.
6. Let the mass fall until it is just about to hit bottom and click ‘stop’. Stop the metal disk from rotating so the string will not become tangled.
7. Highlight in yellow **all** of the non-zero data points that appear to be on a straight line. Don’t just highlight the first few. Click ‘Fit’ and select ‘Linear Fit’. RECORD the slope, which gives the linear acceleration. Click on Fit and deselect Linear Fit. Click in an open area to remove the highlighting.
8. Locate the last data point on the straight line. Using the smart cursor, note the time at which it occurred.
9. Now click on the table that is partially hidden under the velocity graph. RECORD the final velocity and the angular velocity at that same time. You may need to use the scroll bar on the right. RECORD as ‘height’ the value for the position at that same time. Be careful. All three values recorded (ω, v, and h) should be taken at the same time value on the chart. They may not all be on the same horizontal line in the table. The time need not be recorded.
10. Make at least three more runs.

Data:

$m_{hanging}$ (g)	r_{pulley} (cm)

a (m/s^2)	h (m)	v_f (m/s)	w (rad/s)

Calculations:

11. Using the data above, calculate the rotational inertia of the metal disk the same way it was done on the rotational inertia lab for each of the four runs. RECORD this in the table below.

I (kg-m^2)

12. Then calculate the initial gravitational potential energy of the hanging mass and RECORD it.

13. Calculate the final translational kinetic energy of the falling mass and RECORD it.

14. Calculate the rotational kinetic energy of the disk and RECORD it.

15. Add the two kinetic energies and RECORD them.

16. Find the percent error between the initial potential energy and the final total kinetic energy, assuming the potential energy is the theoretical value and the total kinetic is the experimental value.

E gravitational potential	K translational	K rotational	K total	% error