PHYS 101 Experiment 5. Moment of Inertia: Rolling and and Sliding

Preliminary work:

Review "Example 5.10 Acceleration Down a Hill" and "Example 10.7 Acceleration of a Rolling Sphere" of the textbook. Calculate the accelerations of the centers of mass if, instead of a solid sphere, we have a solid cylinder, a hoop, or a spherical shell rolling down an inclined plane. Write your result as $a = c\,g\sin\alpha$, where c is a constant, (possibly different) for each of the different objects.

Online Experiment Link:

https://ophysics.com/

Procedure:

1. Open the website given under the "Online Experiment Link". From the top menu choose the menu item "Rotation", and from the appearing drop-down menu choose the experiment "Moment of Inertia: Rolling and Sliding Down an Incline".

2. Read the description given at the bottom of the page. Run the simulation with all object's boxes checked and observe the motion of all objects accelerating down the inclined plane. Write your observation in your report.

3. Uncheck all boxes except the the one of the frictionless cube so that only the frictionless cube is seen on the inclined plane. Set the "Incline Angle" parameter to $\alpha = 10^o$ so that the acceleration of the frictionless cube down the incline is $a = g\sin\alpha$. Run the simulation 5 times, each time measuring the time it takes for the cube to reach the bottom of the incline and stop. Take the average of the five measurements made and find the time it takes the frictionless cube to reach the bottom of the incline. Explain in your report why five measurements are made instead of a single measurement.

4. Using your time measurement and the value of the acceleration, find the distance traveled by the cube during this time, which is equal to the length of the incline. (Take $g = 9.8\,m/s^2$.)

5. Uncheck the box of the frictionless cube and check the box of solid cylinder so that only the solid cylinder appears on the inclined plane. Reset and run the simulation 5 times, each time measuring the time it takes for the solid cylinder to reach the bottom of the incline and stop. Take the average of the five measurements made and find the time it takes the solid cylinder to reach the bottom of the incline. Use the length of the incline found in the previous step and the time found to calculate the acceleration of the center of the solid cylinder down the inline. Writing it as $a = c\,g\sin\alpha$, determine the constant c for the solid cylinder.

6. Repeat the above procedure for the cylindrical shell, solid sphere, and the spherical shell.

7. Write a properly formatted report of your results, convert it into a PDF file and upload it to MOODLE. Deadline for submission is Monday, 17 August 2020 at 07:59 (am). Late submissions will result in deduction of 10 points for each day late.