Name, Last Name: **Department:** **Course Code – Section**

Title: How fast will different types of cylinders roll down an inclined plane?

Summary: An experiment will be caried out to see how fast a cylindrical object will roll down an incline and compare this with the theoretical predictions. Cylindrical objects of different masses, and cross sections will be used. Inclines at a number of angles will be constructed. A chronometer and a balance for mass measurement and a ruler for radius measurement will be needed.

Research: The course textbook was the main source for the theoretical analysis related to the experiment. The youtube videos

- Objects rolling down an incline demo, by Prof. Lewin (http://www.youtube.com/watch?v=grMGhHFz4Bs),
- Solid Cylinder Rolling Without Slipping Down an Incline, By. Prof. Lewin (http://www.youtube.com/watch?v=7abmkvIpfE8),
- Finding Acceleration of a Rotating Object Down an Inclined Plane (http://www.youtube.com/watch?v=gj9H1Ti4yc0), were

also useful.

Description of the experiment: The experiment will have two parts.

The first part will be a non-quantitative observation of the rolling event. The theory predicts that cylinders with different masses or lengths will roll down at the same speed as long as their radii are the same. Three cylinders of same radius but different lengths and masses will be observed as they roll down the incline (in pairs) at various angles of inclination. Two cylinders with different radii will also be rolled down to observe the dependence on radius. Next, two cylinders with same radius, but one filled, and the other formed as a pipe will be observed.

In the second, quantitative part of the experiment, the total rolling time down the incline will be measured, and compared with theoretical predictions. The theoretical rolling down time for an incline of length L and angle θ is

$$t = \sqrt{\frac{2L\left(1 + \frac{I}{MR^2}\right)}{g\ \sin\theta}}$$

where M, I and R are the mass, moment of inertia (with respect to central axis) and the radius of the cylinder respectively. g is the acceleration due to gravity. This equation shows that for constant L, $t^2 g \sin\theta$ should be constant for each object, and should be equal to $2L\left(1 + \frac{I}{MR^2}\right)$.

For a number of cylinders, each will be rolled down a 1m long incline, at different angles and t will be measured. This will allow the determination of moment of inertia for each of the cylinders.