Lab 13: Round and Round

Goals: Improve communication skills; Improve ability to make, describe, and record observations; Gain exposure to and experience with a wide variety of rotational phenomena; Have fun with physics phenomena

Equipment, Groups & Lab Notebook: Varies depending on station. Include rough sketches of each experimental set-up in your lab notebook. Work as a whole class, with individual students taking turns to participate in particular stations. Record activity and qualitative observations. Update Table of Contents. General Lab Notes guidelines.

Getting Started: Today’s activities will be a combination of discussion and demonstration. For each station, note as appropriate the equipment (including a rough sketch), the activity, and qualitative observations. Some of what you will observe/experience can be explained with physics we have previously studied, and the rest can be understood with physics we are about to study.

Station A: Ramp and Roll
The two disks are the same mass and have the same radius: one disk has more of its mass concentrated near its center while the other disk has more mass concentrated near its edge (rim). Release both disks from rest from the same height on the ramp, so that they have a “race” to reach the bottom. Which configuration wins, or do they tie?

Station B: Wheel Walk
a) Hold the bicycle wheel (not spinning) in your hands in front of you (like you are a zombie holding a bicycle wheel). Orient the wheel so that it is vertical. Walk forward. While walking, turn right. While walking, turn left.
b) Now, spin the wheel as fast as you can. Repeat your previous motion: walk forward; then, while walking, turn right; then, while walking, turn left. What do you feel? What do you observe the wheel to do?

Station C: What the Wheel?
Hang the wheel from the ceiling. Hold the wheel so that it is vertical, then let it go. What happens? Now, hold the wheel so that is vertical and spin it very fast. Now let it go: what happens?

Station D: Ho-Ho-Hoberman Sphere
a) With the Hoberman sphere fully expanded and not rotating at all, pull down on the central string to see it collapse. What direction is the string pulling? Can this twist the sphere?
b) Now, release the string to expand the sphere. Give it a little bit of spin about its central axis, and pull the string again. What do you observe about the motion of the sphere? What do you observe about the effort required to pull the string (compared to the previous case when the sphere wasn’t spinning)?

Station E: Sit and Spin
a) Sit on the stool with your arms close to your body and your legs close to the chair (optional: hold a weight in each hand, close to your body). Make sure that when you extend your arms and legs that you won’t hit anything. Bring your arms and legs close in again. You will be gently spun. You should be spinning freely. Extend your arms and legs out. What happens? Bring your arms and legs back in. What happens?
b) If you are feeling adventurous, you can repeat this activity, starting with a faster initial spin.
c) If you are feeling REALLY adventurous, you can start with your arms and legs extended for the initial spin, and then bring your arms and legs in – but please be very careful and make sure your partner is ready to spot you!

Station F: Wheel Sit and Spin
a) Sit on the stool with your feet firmly planted on the ground. Your partners should get the bicycle wheel spinning as fast as they can, then hand it to you (with your feet still on the ground). You should hold the wheel so that is oriented horizontally, spinning clockwise as viewed from above. Now, lift your feet off the ground. You should be stationary. Next, flip the wheel so that now it is spinning counterclockwise as viewed from above. What happens?
b) Next: flip the wheel back so that it is again spinning clockwise as viewed from above. What happens?
c) If needed, have your partners spin the wheel back up to speed. Put your feet back on the ground so that you are stationary. Again, lift your feet off the ground. You should be stationary. As before, hold the wheel horizontally, spinning clockwise as viewed from above. This time, bring the wheel in contact with the seat of the stool or with your pants (but not bare skin) so that the friction brings the wheel to a stop. What happens?

Station G: When Wheels Collide
A horizontally oriented disk rotates about its central axis. Another nearly identical disk is dropped from above to land directly on the rotating wheel. What happens? Note: we’ll collect data using the Rotary Motion Sensor for later analysis.