INS Physics Lab 1 Rotational dynamics, Buoyancy, and Pressure

1. <u>Angular momentum</u> Sit in the chair/stool and fix it in place - you might put your foot on the ground or the foot rest. Hold the bicycle wheel so that its axle is perpendicular to the ground. Have your lab partner spin the wheel.

   - Note the direction of the wheel's spin and the direction of the angular momentum vector of the system (consisting of you and the wheel). Lift your foot so the chair/stool can rotate freely.
   - Before you flip the orientation of the wheel, predict what will happen when the wheel's axle is inverted. Explain your answer using angular momentum. Flip the wheel and compare the outcome with your prediction.
   - Come to a rest. Again hold the stool in place. Hold the wheel with the axle parallel to the ground and have your lab partner spin the wheel. Note the direction of the wheel's spin and the direction of the angular momentum vector of the system (consisting of you and the wheel). Before you tip the wheel so that the axle points up, predict what you will experience when the wheel's axle is tilted. Explain your answer using angular momentum. Tilt the wheel and compare the outcome with your prediction.

Conclusion What does this have to do with riding a bicycle?

2. <u>Moment of Inertia</u> The hoop and all the wheels have the same radius. The hoop and the wheels with the lead plugs have the same mass.

   - Before rolling them down the ramp, predict in which order the hoop and wheels reach the bottom. Use moment of inertia in your explanation. Race the wheels and compare the outcome with your prediction.

Conclusion You may need to look up how flywheels are used in various designs. A flywheel is supposed to go around and around and be very hard to stop. Based on your experimental evidence, how would you design a flywheel?

3. <u>Water Pressure</u> With the bottle in the *bottom* of the sink, hold the three holes and fill the bottle to the line indicated. The full water level is 20 cm. The three holes are at 5, 10, and 15 cm.

   - Before you let the water out of the holes, predict which stream will go the farthest. Explain. Let the water out and compare the outcome with your observation.
   - Repeat the above, this time with the bottle at the *edge* of the sink (so that the water can flow into the bottom of the sink).

Conclusion What factors contribute to the different results?

4. Buoyancy

   - Hook the spring scale to the ring stand and record the weight of the lock.
   - Fill *about* 700 ml of water into a 1000 ml beaker. Record the level of the water as accurately as possible.
   - Lower the lock all the way into the water and record the level. What does the difference of the above two water levels measure?
   - Raise the lock out of the beaker and let the water drain from the lock. Check that the water is back to its initial level. Take the lock off the ring stand and set it upright into the bottom of the styrofoam cup. Take the cup and lock "boat" and carefully float it in the beaker. Record the water level. What does the difference of this last level and the initial level measure? Does this match some other measurement made earlier? (Hint, hint.)

Conclusion How would you determine the carrying capacity of the styrofoam cup "boat"?

5. Archimedes Principle and Density

   - Fill *about* 30 ml of the liquid provided into the graduated cylinder. Carefully record the volume.
   - Hook the spring scale to the ring stand and weigh the metal cylinder(in air).
   - Lower the cylinder until it is submerged in the liquid and weigh it. Record the level of the liquid with the cylinder submerged.
   - Why does the cylinder apparently weigh less while it is submerged in the liquid?
   - Calculate the density of the liquid? Is it likely that the liquid is just water?

Conclusion Why is it easier to float things in the Great Salt Lake? Use Archimede's Principle in your answer.

There will not be an overall conclusion for this lab. Answer the concluding question for each section.