8.2: Activities

Equipment

- rotating cradle + metal disk, with string around hub
- iron ring
- pulley assembly
- hanging weights
- digital scale
- 2-meter stick
- vernier calipers

The General Idea

As we did in Lab #4 with static friction, we will be measuring a physical quantity using two very different methods, and then compare the two results, looking for confirmation. In this case, the quantity we will be measuring is the moment of inertia of a heavy iron ring. One way that we will measure its moment of inertia is dynamically, as detailed in the Background Material. The second method is up to you, but it will not involve the rotating cradle apparatus. You are of course free to measure any aspect of the ring's physical features that you wish, and you can use whatever formulas you can find in the textbook.

Some Things to Think About

This lab incorporates many things you have done before, so the direction you are given is intentionally pretty scant. Still, when it comes to the dynamic measurement, here are a few things to keep in mind:

- ***Important! – For the turntable to work properly, the string must wrap around the hub. This is only assured when there is tension in the string. If the string goes slack while the turntable is rotating, the string will wrap around the axle rather than the hub, and there's a good chance this will render the turntable inoperable.***
- You have some already computed accelerations of objects dropped from rest (Lab #3 on air resistance), so you should draw on that experience in this lab. One suggestion for a change from that procedure is that the start of the timer can be easily be synchronized with the release of the rotating platform if both tasks are performed by the same person.
- Upon reading the Background Material, you undoubtedly figured out that there is a best-fit line (actually, two) in your future. Go ahead and use the online calculator for this.
- When you find the moment of inertia dynamically, you have calculated it for the *object that is rotating*. In this case, what is rotating is *not* just the iron ring – the metal disk under the ring and cradle itself are also involved. How will you account for this? The additive property of moments of inertia around a common axis seems like it will be useful, but don't assume there is a quick-fix – a separate experiment may be needed.
- If you are unfamiliar with how to make measurements with the vernier calipers, ask your TA for assistance.
- Use great care when handling the iron ring to weigh it. If it rolls off the scale, it can do a great deal of damage to someone's foot.
- Keep in mind that you want the weight to drop far enough to keep the percentage uncertainties in distance and time quite small (say, below 1%), while not allowing the platform to get spinning very fast (which brings in air resistance error). This will require a judicious choice of your range of hanging weights. Note that if/when you do two separate experiments, you do not need to use the same range of weights for both.
- Of the two methods of computing the moment of inertia, the dynamic one carries by far the most uncertainty. As (in this class) we do not deal with uncertainty of values we find graphically, uncertainty computations will not be part of this lab. Meticulous care in taking data is still paramount, however, and this should allow you to reach agreement between the two measurements that is within 5%. If the disparity is more than this, but less than 10%, then that is probably because the data could have been gathered more carefully. If the disparity is more than 10%, then you almost certainly made a critical error or omission somewhere.

Lab Report

Craft a lab report for these activities and analysis, making sure to include every contributing group member's name on the front page. You are ***strongly encouraged*** to refer back to the Read Me as you do this, to make sure that you are not leaving out anything

important. You should also feel free to get feedback from your lab TA whenever you find that your group requires clarification or is at an impasse.

Every member of the group must upload a separate digital copy of the report to their lab assignment in Canvas *prior to leaving the lab classroom*. These reports are not to be written outside the lab setting.
