Name: _____ Phys 12

Lab: Investigating Torque

Purpose: In this lab, you will investigate the relationship between the mass of a hanging object and the distance it is hung from the pivot of a stationary "see-saw".

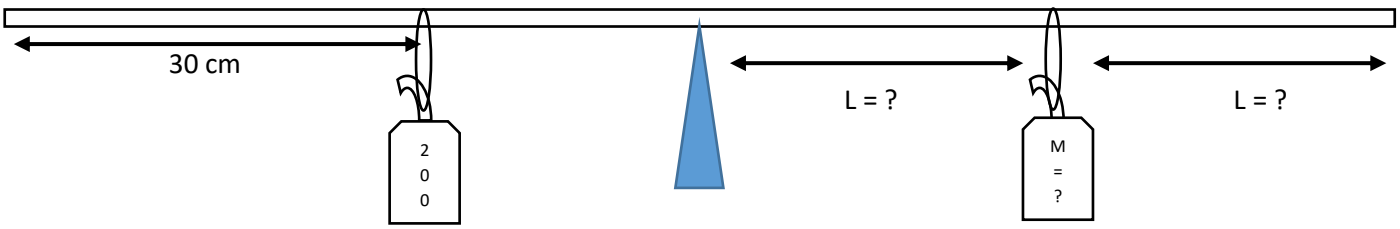
Independent variable: Mass (kg)
Dependent variable: Moment arm or distance to pivot (m)

Materials:

- Meter stick
- Various masses
- String
- Clamp and balance support
- Scissors
- Tape?
- *(Electronic mass balance)*

Procedure:

1) Determine the centre of mass of your meter stick (your meter stick is likely not uniform). Do so by holding balancing the stick with your two index fingers at either end of the meter stick and sliding them together. The point they meet should be the centre of mass.
2) Slide your meter stick through the clamp until the center of the clamp is at the center of mass. Place the meter stick with clamp on the balance support and adjust if needed. Your meter stick should be perfectly balanced. Record the position of this center of gravity with appropriate uncertainties.
3) Use the scissors to cut 2 pieces of ~ 20 cm string. Make 2 sturdy loops with the string that can be slid through the meter stick and can have masses hung from them.
4) Take one loop of string and slide it through the meter stick until it's at the 30-cm mark. You want to make sure this string stays in place for all your trials, so you may tape this down on your meter stick if you'd like.
5) Hang a 200-g control mass on the loop of string you just attached to your meter stick. Your meter stick will no longer balance (if it hasn't already from step 4). Keep this set up the same for all your trials.
6) Slide the other loop of string **on the other side** of the meter stick where the 200-g mass is hung.
7) Attach a 1000-g mass on the loop of string in step 6. Slide this loop of string with the 1000-g mass carefully until your meter stick is completely balanced. Record the distance between the pivot and the loop of string (with the 1000-g mass attached). Remember to include significant figures and uncertainties in your recordings.
8) Repeat step 7 for various masses of your choice. You may attach >1 mass to your string by hooking the 2nd mass on the 1st one (underneath) to further vary your mass for that trial. Make sure you have tested at least 5 different masses. You may conduct multiple trials of each mass (AND/OR more >5 different masses) if time allows.
9) Record the uncertainties for all masses to be ± 0.1g.



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Hand in:

- Data tables with appropriate units, significant figures, and uncertainties
- Data analysis (more details below)
- Discussion evaluating your data and the methodology of the lab (refer to rubric)

Data analysis: You will need the following (review from last year):

- Graph of your independent and dependent variable including error bars and best fit line.
- Linearized graph with correctly propagated uncertainties, best fit line, max/min slope, and slope uncertainties
- Finding the meaning of your slope, compare it to known values, and calculate percentage difference accordingly
- Calculations shown on other pages attached

DUE DATE: Dec 15

Bonus Challenge 1

Conduct the same lab except adjust the pivot to the 30-cm mark. Your control mass is a 500-g mass hung at the 10-cm mark. You will need an electronic mass balance to measure the mass of YOUR meter stick before you leave. If you are also attempting Bonus Challenge 2, you must do that first before measuring your meter stick on the electronic balance.

Bonus Challenge 2

*You may attempt this challenge only after collecting all your data. Your task is the **find the mass of the meter stick** using only these following materials (pretty much same as your lab minus the electronic balance):*

- *clamp and balance*
- *various masses*
- *string and scissors*
- *tape?*
- *meter stick*

Draw a diagram of the set up you used to complete this challenge making sure ALL masses and lengths are labeled on this diagram.

Record your experimental mass of your meter stick with uncertainties below. Measure your meter stick using an electronic mass balance and record the actual mass below.

_____ _____

Experimental mass Actual mass