Lab 10-1: Introduction to Torques

Purpose: 1. To qualitatively differentiate between force and torque.
2. To develop a definition of torque.

Equipment: 1 meter stick, 3 jumbo paper clips, string, one 1/2 kg mass, two 50 gram hangers, 150 grams slotted masses, stand and clamp, protractor, force probe

Procedure:

Part I: Qualitative difference between force and torque.

1. Hold the meter stick so that you are just holding the first few cm of the stick. Using a paper clip, hang the 1 kg mass at about the 10 cm mark.
2. Rotate the meter stick up and down. Note how difficult it is to rotate the meter stick.
3. Repeat step 2, each time sliding the mass out about 20 cm further. Answer question 1 now, in case you forget.
4. Make sure everyone in the group does this!

Part II: Quantitative analysis of torques

1. Hang the meter stick from the stand and clamp so that it is balanced. (Hopefully it balances very close to the 50 cm mark!)
2. At the 90 cm mark, hang a 50 gram hanger from the meter stick using a paper clip.
3. On the other side of the meter stick, find the distances so that you can balance the meter stick using 200 grams. (One 50 gram hanger + 150 grams slotted masses) Record this in the data table. Also record the weight of the 200 gram hanger.
4. Repeat step 4 using 150 grams total mass, then 100, and finally 50 grams.

Part III: Torques with angles

1. Hang a total of 200 grams from the 90 cm mark. At the other end of the meter stick, use a short string to attach the force probe. The string should be long enough to use a protractor to measure the angle between the string and the meter stick. Make sure the probe is set to read on the 10 N scale, and not the 50. Zero the force probe if needed.
2. Always trying to keep the meter stick level, record the force needed to balance the hanging masses for the different angles in the table below. (The angle between the string and the meter stick is 90º when the string is perpendicular to the meter stick.)

Data:

Part II

used to balance...	*weight (N)*	*radius (cm)*	*weight (N)*	*radius (cm)*
200 grams	0.5	40		
150 grams	0.5	40		
100 grams	0.5	40		
50 grams	0.5	40		

Part III

Radius (m)	Force (N)	Angle (º)	Force ⊥ (N)	Force // (N)
		90º		
		75º		
		60º		
		45º		
		30º		
		15º		

Lab 10-1: Introduction to Torques

Questions:

Part I

1. Describe what happened as you moved the half kg mass out along the meter stick. Did it get easier or harder to rotate?

2. Did the weight of the half kilogram mass change as you slid it out along the meter stick?

3. Explain how your answers to questions 1 and 2 make sense.

Part II

4. In each case, you were balancing the exact same weight on the other side of the meter stick. You were able to balance the meter stick with a variety of weights, however. What is the relationship between force (weight) and the distance through which it is applied for balancing something?

Part III

5. Calculate the components of the tension in the string both perpendicular and parallel to the meter stick. Show your calculations for one of the trials here, and record all the results in the data table.

6. What was (hopefully) constant for all the trials?

Conclusions:

1. Describe the difference between force and torque.

2. Keeping in mind that the torques were always balanced in this lab, what is the definition of torque?

3. Why are door knobs usually placed at the far edge of the door, away from the hinges?

4. How can two kids of very different weights play on a see-saw?