

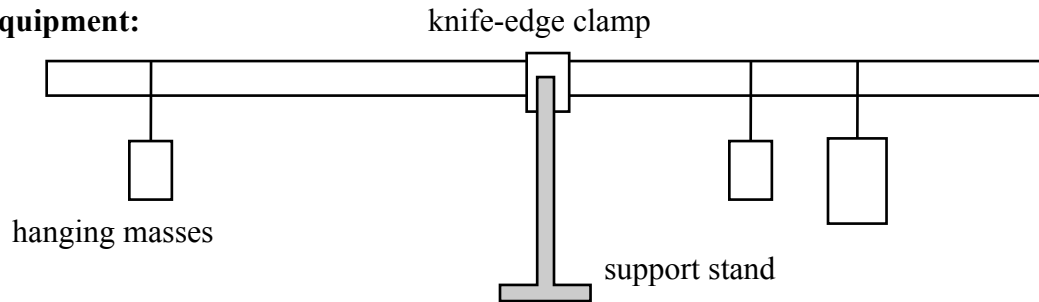
Name: _____

Lab Partner: _____

Survey of Physics Lab Exercise 8: Torque Equilibrium

Purpose: You will verify that total clockwise torque balances total counterclockwise torque for objects in equilibrium. You will also use the conditions of equilibrium to find unknown forces.

Diagram of equipment:



Theory:

An object at rest is in equilibrium, and the following two conditions are true:

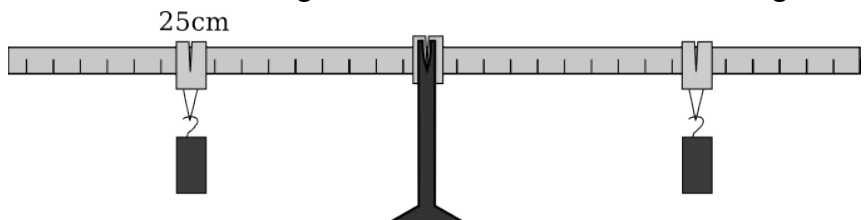
- All forces balance. The total upward force must equal the total downward force.
- All torques balance. The total clockwise (cw) torque must equal the total counterclockwise (ccw) torque.

We will apply these rules to a meter stick with hanging weights.

Procedure:

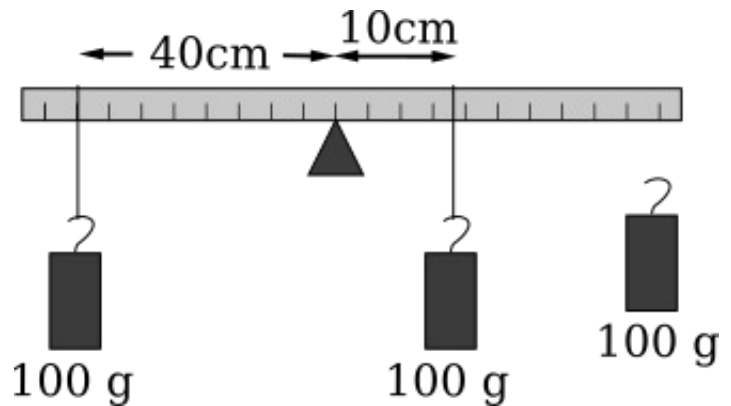
Part A

1. Set up the meter stick balanced at its center of gravity. Attach 150 g to a hanger on the 25 cm mark and 100 g to a hanger on the opposite side. Move the 100 g until balance is achieved. Don't forget to **include the mass of the clamp** as part of the 150 g and 100 g masses.



Part B

1. Set up the meter stick balanced at its center of gravity. Attach 100 g to a hanger on 40 cm from the pivot, and another 100 g on the other side, 10 cm from the pivot. Obtain another 100 g mass and hang it on the right. Move the 100 g until balance is achieved. Don't forget to **include the mass of the clamp** as part of the masses.



2. Compute the clockwise (cw) and counterclockwise (ccw) torques. Record and compare them. (They should be approximately equal.)

Part C

1. Move the support stand to the 30 cm mark on the meter stick. Hang a weight only on the short side of the meter stick and move the weight to achieve balance.
2. Record the mass (including hanger) and distance of this counterweight from the pivot.

3. One torque is caused by the mass that you have attached. The other torque is caused by the weight of the meter stick, which acts at the stick's center of gravity. Draw a sketch of the system that includes the meter stick, support, the hanging mass, and the weight of the meter stick.
4. By setting the CW torque equal to the CCW torque, you should be able to find the mass of the meter stick. Show your work to find the mass of the meter stick.
5. Now take everything off the meter stick and weigh it. Find the percent difference between these masses.

Note: percent difference between a and b is given by $\frac{a - b}{\frac{1}{2}(a + b)} \times 100$