Name: _____ Name: _____

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Static Equilibrium Using a Meter Stick Activity

Note on grading: Your lab score in large part will be based on how accurately your group performs the lab activities. Cheating during any part of the lab activity will result in a grade of zero.

Attach your work for all parts.

Purpose:

Using $\sum\tau = 0$ for a rigid body in static equilibrium, the students will practice predicting where masses must be hung on a meter stick/fulcrum system to place the system in static equilibrium. The students will also be required to determine two unknown masses simultaneously using the same meter stick/fulcrum system.

Part I

Hint:

1. Although the meter stick has mass, you will not be allowed to weigh the meter stick to determine its mass.
2. Typically, the meter stick's center of mass is not located at 50cm.
3. Since you do not know the mass of the meter stick, you must choose your pivot point wisely.

Using the given conditions that follow, predict where the mass(es) must be hung to place the meter stick/fulcrum system in static equilibrium. Your predictions should correspond to markings on the meter stick, not the distance between the fulcrum and the mass. After you have made your prediction, experimentally determine the position of the mass required to place the system in equilibrium then compare the experimental results to your prediction.

A. (10 points)

Hang a 50g mass at the meter stick's 20cm mark. Predict where a 70g mass must be hung to put the system in static equilibrium.

Predicted Position	Experimental Position

B. (15 points)

Hang a 50g mass at the meter stick's 10cm mark and a 70g mass at the 40cm mark. Predict where a 100g mass must be hung to put the system in static equilibrium.

Predicted Position	Experimental Position

C. (Points are indicated below)

Hang a 70g mass at the meter stick's 10cm mark. Predict where an 100g mass and a 50g mass must be simultaneously hung to put the system in static equilibrium. The distance between the 100g and 50g masses must be 10cm. (Hint: There are two solutions to this problem.) Your grade will be based on how far the fulcrum needs to be moved from the Meter Stick's center of mass to establish equilibrium. You may test your predictions prior to having your TA test your predictions.

Provide a diagram of your system. The location of the meter stick's center of mass and pivot point must be clearly shown. Use appropriate ***variables*** to describe the unknown positions of the 100g and 50g masses (5 points -- all or none):

Provide the Torque Equation for the system and an equation relating the distance between the 100g and 50g masses. Both equations should use the same ***variables*** used in the diagram above.
(10, 8, 6, 4, 2, or 0 points possible)

Part C Continued

Predicted Position of 100g Mass	Predicted Position of 50g Mass	Position of the Meter Stick's CM (A)

You may begin working on Part II while you wait for your TA

TA to complete this table.

TA Verification that the 70g mass is positioned at 10cm.	TA Verification of the 100g mass position.	TA Verification of the 50g mass position.	Position of the fulcrum needed to establish equilibrium (B)	Absolute difference between (A) and (B) in millimeters

Absolute Difference (mm)	<=1	<=2	<=3	<=4	>4
Points	10	6	3	1	0

Part II

During Part II, you may not use any of the masses or mass hangers located at your station; only the unknown masses may be hung from the meter stick. Using known masses, mass hangers, or a scale to determine the masses of your unknowns will result in a grade of zero for the entire lab.

Determine the mass of each of the unknown masses that you have been provided using only the meter stick/fulcrum system. Your TA will weigh your two unknowns simultaneously and provide you with the total mass. After you have predicted the masses of your unknowns, your TA will weigh the unknowns individually and determine the actual individual masses. Your grade will be based on the percent difference of each predicted mass. (Hint: minimize measurement error by maximizing the distances the masses are from the pivot point)

Total mass of both Unknowns as determined by the TA: _____

Unknown Mass	Predicted Mass in grams (a)	Actual Mass in grams (b)	Percent Difference $= \frac{\lvert a-b \rvert}{b} x100\%$	Score from Table Below

Percent Difference	<=0.3%	<=0.4%	<=0.5%	<=0.6%	<=0.7%	>0.7%
Points	25	23	21	18	16	12