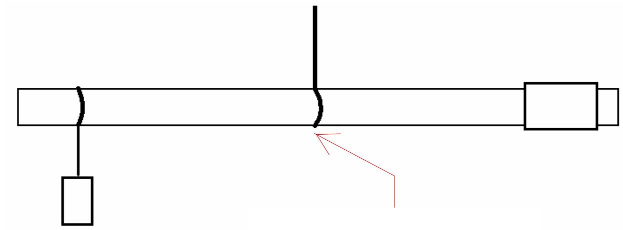
Each person records their own data and calculations.

Name: ______________________________
Date: ____________________ Period: _____

TORQUE LAB

Purpose: To use balanced torques to find the center of gravity of a mass loaded meter stick.

Materials/ Apparatus:
Given this lab set-up, **label** F_1, F_2, d_1, d_2, the Center of Gravity (CG), and the fulcrum (f).



$$\Sigma T = 0 Nm$$

$$F_1 d_1 = F_2 d_2$$

Hint: Something's force of gravity acts at its center of mass!

NOTE! MEASURE EVERYTHING TO THE NEAREST 0.1 CM AND RECORD FORCES TO THE NEAREST 0.01 N.

Procedure:

1. **Weigh** the mass loaded meter stick. **Record** above data table. F_2
2. **Suspend** the meter stick and hang a known weight, F_1, at a random point on the unloaded end.
3. **Slide** the fulcrum along the meter stick until it *balances*. The meter stick *is not balanced* until it is completely level and does not torque (spin).
4. **Record** the value of F_1, the position of F_1, and the position of the fulcrum for Trial 1 in the table.
5. Use simple subtraction to **calculate** d_1 (distance from F_1 to the fulcrum) and record in the table. (*for example:* if the fulcrum is at 30 cm and F_1 is at 21 cm, d_1 is 9 cm)
6. Use the Torque equation listed above to **calculate** what d_2 (distance from the Center of Gravity to the fulcrum) for Trial 1 and record in the table.
7. Use simple addition to **calculate** the position of the Center of Gravity for Trial 1 and record it in the table. (*for example:* if the fulcrum is at 30 cm and d_2 is 5.5 cm, the Center of gravity is at 35.5 cm on the meter stick)
8. Repeat steps #2-7 with a different hanging mass or different location. Record this data as Trial 2 in the table.
9. Repeat steps #2-7 with a different hanging mass or different location. Record this data as Trial 3 in the table.
10. Find the average calculated position of the Center of Gravity for the three trials and record.
11. Determine the actual Center of Gravity of the meter tick by balancing it directly with no additional hanging mass. Record it in the table.
12. Calculate the percent error between the actual (experimental) Center of Gravity you found in calculated (theoretical) Center of Gravity.

F_2 = ____________________ N

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Hanging weight (F_1)				
Position of F_1				
Position of Fulcrum				
Distance from F_1 to fulcrum (d_1)				
Distance from CG to fulcrum (d_2)				
Calculated position of CG				

Average calculated Position of Center of Gravity: ____________________ cm

Actual balance point (Center of Gravity) of mass loaded meter stick: ________________ cm

Show at least one d_2 calculation below:

$$d_2 = \frac{F_1 d_1}{F_2} = \quad \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ =$$

Show your percent Error Calculation below:

$$\%Error = \frac{CG_{Actual} - CG_{Calculated}}{CG_{Actual}} x100 = \quad \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ =$$

Questions:

1. I believe some causes to our error were: (*list at least three possible errors in complete sentences*)

2. A loaded meter stick, such as was used in your lab, is balanced on a fulcrum by handing an additional weight from it and adjusting the position of the fulcrum. Calculate the *distance* from the fulcrum to the center of gravity. The following data is given:

DATA:

- Hanging weight = 2.0 N
- Weight of loaded meter stick = 3.5 N *(without hanging weight)*
- Position of hanging weight = 7.5 cm
- Position of fulcrum = 42.5 cm