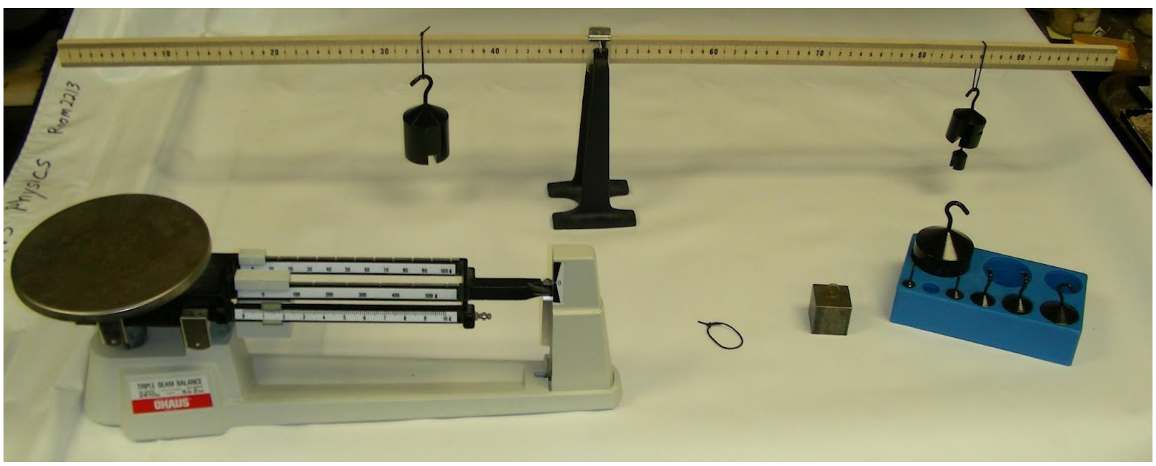
Name______________________ Date_____________

PHYS 1401 General Physics I
Torques

Equipment

Fulcrum and attachment
Triple Beam Balance
Meter Stick
Mass Set
3 String loops
Unknown Mass



Theory

For a body to be in static equilibrium, two conditions have to be met:

and

where

F is force

τ is torque. (The torque is the force times the lever arm, *r*)

The first condition, , is concerned with translational equilibrium and ensures that the object is not moving linearly or is moving at a uniform linear velocity.

The second condition, , is concerned with rotational equilibrium and ensures that the object is not rotating or rotating at a uniform angular velocity.

Procedure (For each setup, draw a scale diagram of the setup)

1. Measure the mass of the meter stick without attachment and then place the meter stick on a support stand. Adjust the meter stick through the attachment until the stick is balanced on the stand. The balancing point is called the center of mass of the meter stick. Record this point.
2. **Case 1**. With the meter stick on the support stand, suspend a gram mass at the 15-cm mark on the meter stick. Then adjust the lever arm for a gram mass at the other end of the meter stick.
3. Record the mass and position *x* as read on the meter stick and then record the lever arms. Compute the torques and find a percent difference between the clockwise (τ_{cw}) torques and counterclockwise (τ_{cc}) torques.
4. **Case 2.** Place at the 20-cm mark and is at the 60-cm mark on the meter stick. Experimentally determine the position for so that the system is in equilibrium. Follow a procedure similar to steps 2 and 3. Compute the percent difference of the clockwise and counterclockwise torques.
5. **Case 3.** Place an unknown mass at the 10 cm mark of the meter stick. Suspend from the other side a counter mass and adjust its position until the system is in static equilibrium. Using, , calculate the unknown mass m_1. Remove the unknown mass and determine its mass on the laboratory balance. This is the accepted mass. Calculate % error.
6. **Case 4.** Suspend a mass at or near the zero end of the meter stick. Move the meter stick in the support clamp until the meter stick is in equilibrium. Record this new equilibrium position as $\boldsymbol{x_o}$'. Using the total mass of the meter stick, calculate the clockwise and counterclockwise torques, and then calculate a percent difference. In this calculation, you will include the mass of the meter stick as if it were concentrated at its center of mass, x_o (around the 50 cm mark) calculating the lever arm to the new pivot point.

<u>Data Table</u>

Mass of meter stick, $m_{meterstick}$ ________________________

Balancing point (center of mass) of meter stick, x_0 = _______________

* Attach a sheet to the laboratory report showing diagram and calculations for each use.

Values	Moment (lever) arms	Results *(see note above)
Case 1		
m_1 = 100 g x_1 = 15 cm m_2 = 200 g x_2 = __________	r_1 = ____________ r_2 = ____________	τ_{cc} = ____________ τ_{cw} = ____________ Perc.Diff. ___________
Case 2		
m_1 = 100 g x_1 = 20 cm m_2 = 200 g x_2 = 60 cm m_3 = 50 g x_3 = ________	r_1 = ____________ r_2 = ____________ r_3 = ____________	τ_{cc} = ____________ τ_{cw} = ____________ Perc.Diff. ___________
Case 3		
m_1 =? x_1 = 10 cm m_2 = 300 g x_2 = __________	r_1 = ____________ r_2 = ____________	m_1 _____________ (measured on scale/ accepted) m_1 _____________ (calculated, experimental) Perc. error __________
Case 4		
m_1 = 100 g x_1 = _________ $m_{meterstick}$ = ________ x_o = ________ x_o' = ________	r_1 = ____________ r_2 = ____________	τ_{cc} = ____________ τ_{cw} = ____________ Perc.Diff. ___________