Physics 12 - Yael, Aryan, Daejung - Equilibrium Project

Numbers - recorded:

fulcrum point (top, 1st layer) = blue highlighter

1kg mass (top) = 0.0810m from fulcrum point

0.5kg mass (top) = 0.153m from fulcrum point

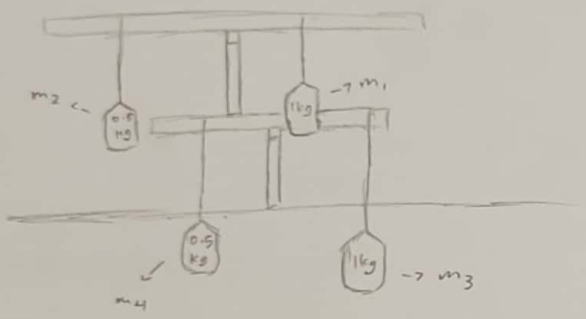
→ distance between fulcrum points = 0.0655m

fulcrum point (bottom, 2nd layer) = purple highlighter

1kg mass (bottom) = 0.155m from fulcrum point

0.5kg mass (bottom) = 0.0740m from fulcrum point

Diagram:



Calculations:

* The mass of the rulers are negligible, therefore in our sources of error there are none related to the mass of the ruler

- top, 1st layer

$m_1 \cdot 0.0810m = m_2 \cdot 0.153m$

$1kg \cdot 0.0810m = 0.5kg \cdot 0.153m$

$0.0810 = 0.0765$

$\Sigma T_{cw} = \Sigma T_{ccw}$

- bottom, 2nd layer

$(m_1 + m_2 \cdot 0.0655m) + (m_4 \cdot 0.0740m) = (m_3 \cdot 0.155m)$

$(1kg + 0.5kg \cdot 0.0655m) + (0.5kg \cdot 0.0740m) = (1kg \cdot 0.155m)$

$0.135 = 0.155$

$\Sigma T_{cw} = \Sigma T_{ccw}$

Sources of error:

- Bending of the ruler from weights on either side
- greater static friction in heavier weight due to greater surface area.
- mass on weights is not exactly 1kg or 0.5kg

→ other side combined

Sources of error - continued + elaborate (+ detail):

- Mass on weights is not exactly 1kg or 0.5kg
  - -> if the mass has been damaged or not measured properly, it is possible that it's not exactly as labelled as said on weight
- Bending of the ruler from weights on either side
  - -> due to the bending of the ruler from the weights attached on both sides, the string attaching the weight to the ruler could have slightly shifted from the original mark.
  - -> this could cause distances to not be exactly accurate; affecting the torque calculations.
- As mentioned before, we could say a couple sources of error that are related to the meter stick but mass is negligible therefore we don't need any

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- Greater static friction in heavier weight due to greater surface area
  - -> static friction which would affect how easily the mass is moved.
  - -> the lighter weight would have to emit more force to move the heavier weight
    - L> less surface area

Conclusion:

This project has demonstrated how the sum of forces in one direction is equal to the sum of forces in the other direction, which is why we used the formula $\Sigma\tau_{cw} = \Sigma\tau_{ccw}$ to prove that the torque is in equilibrium in both the clockwise & counter clockwise directions. Although there are possible sources of errors that make both sides of our project not exactly the same, they are somewhat close in value which indicates that the calculations are relatively accurate (which was proved on the other page.). Overall, this project was a great way to learn and explore more about equilibrium and to understand how it truly works.