Lab 8: Torque & Static Equilibrium

Learning Goals	Concepts
• Solve for an unknown mass or length to balance the sum of torques equation. • Gain an intuitive understanding of torque.	• Torque • Static equilibrium • Center of gravity

Vocab & Notation

- Mechanical equilibrium
- Translational equilibrium
- Lever arm
- Pivot
- Fulcrum
- Cantilever
- Line of action
- φ

Equations

$$\tau_{net} = \tau_1 + \tau_2 + \cdots \quad (3)$$

$$\tau = rF \sin\varphi \quad (4)$$

$$\tau = rF \quad (5)$$

$$(\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F})$$

Theory Outline

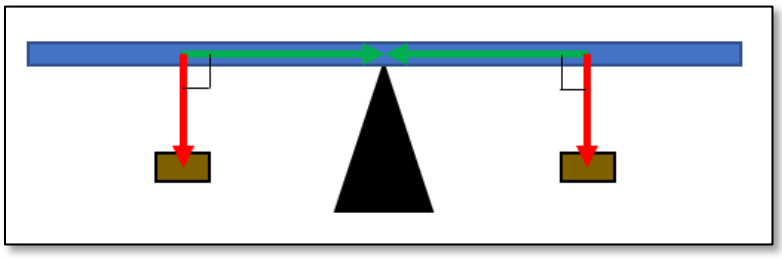
- Compare torque and Newton's 2nd Law – $F = ma$ and $\tau = I\alpha$
- Torque from a single force – *Equation 4*
- Torque from a perpendicular force – *Equation 5, Meter Stick & Torque*
- Sum of torques and static equilibrium – *Equation 3*

Procedure Outline

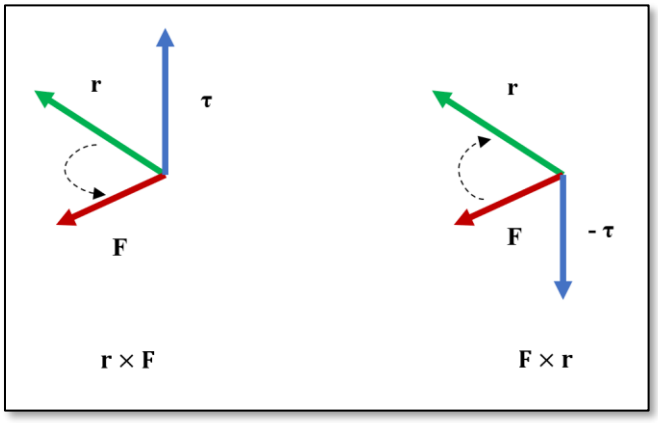
- Calculate an unknown position for mass for each setup.
  - Example: pivot at COM, m_1 = 50 g, x_1 = 10 cm, m_2 = 100 g, x_2 = ?
- Four Setups:
  - One mass on each side of the meter stick
  - Two masses on one side and one mass on the other
  - Pivot at 10 cm and mass at the 5 cm mark
  - Pivot at 10 cm and an upward force applied with a string and hanging mass

Diagrams

Meter Stick & Torque



Vector Cross Product



Four Setups