Flipping Physics Lecture Notes:

Rotational Equilibrium Introduction (and Static Equilibrium too!)

Translational Equilibrium:

- $\sum \vec{F} = 0 = m\vec{a} \Rightarrow \vec{a} = 0$
  - The object is either
    - **at rest** or
    - moving at a **constant velocity**.
      - Note: The mass of an object cannot be zero.
  - Remember to identify
    - **object(s)** you are summing the forces on and
    - the **direction** you are summing the forces in.

Rotational Equilibrium:

- $\sum \vec{\tau} = 0 = I\vec{\alpha} \Rightarrow \vec{\alpha} = 0$
  - The object is either
    - **at rest (not rotating)** or
    - moving at a **constant *angular* velocity**.
      - Note: The rotational inertia of an object cannot be zero.
  - Remember to identify
    - **object(s)** you are summing the torques on,
    - the **axis of rotation,** and
    - the **direction** you are summing the torques in.
  - Realize the rotational inertia of an object cannot be zero.

Static Equilibrium:

- The object is at rest (and therefore not rotating).
- The object is in both translational and rotational equilibrium.
- The net torque equals zero about **any axis of rotation**.

Translational Equilibrium:

$\sum \vec{F} = 0 = m\vec{a} \Rightarrow \vec{a} = 0$

- At Rest or
- Constant Velocity

Identify: Object and Direction

Rotational Equilibrium:

$\sum \vec{\tau} = 0 = I\vec{\alpha} \Rightarrow \vec{\alpha} = 0$

- At Rest (not rotating) or
- Constant *Angular* Velocity

Identify: Object, Direction, and Axis of Rotation

Static Equilibrium:

$\sum \vec{F} = 0 = m\vec{a} \Rightarrow \vec{a} = 0$ & $\sum \vec{\tau} = 0 = I\vec{\alpha} \Rightarrow \vec{\alpha} = 0$

- At rest and not rotating
- $\sum \vec{\tau} = 0$ about ***any*** Axis of Rotation!