Review of angular quantities

- Displacements
  \[ \Delta s = \Delta \theta \]
- Speeds
  \[ v_t = \omega r \]
- Accelerations
  \[ a_t = \alpha r \]

\[ \omega = \omega_i + \alpha t \]
\[ \Delta \theta = \omega_i t + \frac{1}{2} \alpha t^2 \]
\[ \omega^2 = \omega_i^2 + 2 \alpha \Delta \theta \]

Direction of \( v_t \) and \( \omega \)
- Right hand rule

Direction of \( a_t \) and \( \alpha \)
- If rotation is speeding up
- If rotation is slowing down

\( \ddot{a}_t \) quantifies the change in magnitude of \( \vec{v}_t \)
But direction of \( \vec{v}_t \) also changes
Centripetal Acceleration

- Centripetal refers to "center-seeking"
- Quantifies the change in direction of the velocity
- The acceleration is directed toward the center of the circle of motion

The magnitude of the centripetal acceleration is given by

\[ a_c = \frac{v^2}{r} \]

This direction is toward the center of the circle

Centripetal Acceleration and Angular Velocity

- The angular velocity and the linear velocity are related \((v_t = \omega r)\)
- The centripetal acceleration can also be related to the angular velocity

\[ a_c = \omega^2 r \]

Total Acceleration

- The tangential component of the acceleration is due to changing speed
- The centripetal component of the acceleration is due to changing direction
- Total acceleration can be found from these components

\[ a = \sqrt{a_t^2 + a_c^2} \]