Angular Motion

for a Rigid System of Particles about a Fixed Axis

Symbols θ, ω, α, v_t, a_t stand for "1D vectors", *i.e.* signed scalars for which the sign ($+$ or $-$) indicates CCW or CW only.

POSITION $\theta(t)$ and DISPLACEMENT $\Delta\theta \equiv \theta_f - \theta_i$

VELOCITY

$$\bar{\omega} \equiv \frac{\Delta\theta}{\Delta t} \qquad \omega(t) \equiv \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$$

CHANGE IN VELOCITY $\Delta\omega \equiv \omega_f - \omega_i$

ACCELERATION

$$\bar{\alpha} \equiv \frac{\Delta\omega}{\Delta t} \qquad \alpha(t) \equiv \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t}$$

To get a tangential quantity for particle i, multiply the corresponding angular quantity by the radius of particle i.

$$s_i = r_i|\Delta\theta| \quad v_{ti}(t) = r_i\omega(t) \quad a_{ti}(t) = r_i\alpha(t)$$

There is no radial velocity, but there is radial acceleration.

$$v_i(t) = |v_{ti}(t)| \quad a_{ci}(t) = \frac{v_i^2(t)}{r_i} \quad a_i(t) = \sqrt{a_{ti}^2(t) + a_{ci}^2(t)}$$