$$\omega_{av} = \frac{\Delta\theta}{\Delta t} = \frac{\theta_2 - \theta_1}{t_2 - t_1}$$

$$\omega_{ins} = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} \Rightarrow \boxed{\omega_{ins} = \frac{d}{dt}\theta(t)}$$

$$\omega = \frac{v}{r} \Rightarrow \boxed{\vec{v} = \vec{\omega} \times \vec{r}}$$

* If the rotation completes one revolution,

$$\omega = \frac{2\pi}{T}$$

* Its direction determined by right hand rule.

Angular acceleration: The rate of change of angular velocity.

$$\alpha = \frac{\Delta\omega}{\Delta t} \Rightarrow \alpha = \frac{\omega_f - \omega_0}{\Delta t} \qquad \alpha = \frac{a_t}{r} \Rightarrow a_t = \alpha r$$

$$\alpha_{ins} = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t} \Rightarrow \alpha_{ins} = \frac{d}{dt}\omega(t)$$

* All points of a rigid body has the same angular acceleration.

☆ Equation of rotational motion $\vec{\omega}$ constant α.

1. $\omega_f = \omega_0 + \alpha t$
2. $\theta = \left(\frac{\omega_0 + \omega_f}{2}\right) t$
3. $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$
4. $\omega_f^2 = \omega_0^2 + 2\alpha\theta$

Torque: Is the turning effect of the force about the point.

$$\vec{\tau} = \vec{r} \times \vec{F}$$



