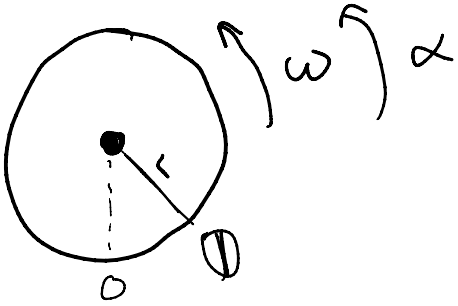
Types of R.B motion

1. Translation
2. Fixed Axis rotation
3. General Planar Motion (T & R)
4. 3D Motion

Every point on a rigid body moves with same velocity and acceleration

$\bar{r}_{B/A} = \bar{r}_B - \bar{r}_A$

Fixed axis rotation



θ = Angular displacement

ω = angular velocity

α = angular acceleration

$$\omega = \frac{d\theta}{dt}$$

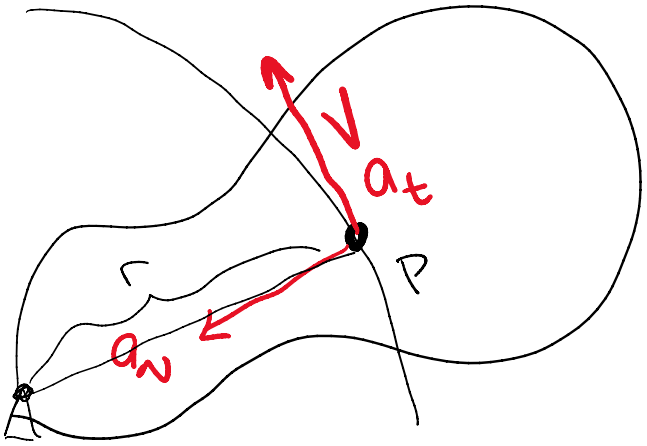
$$\alpha = \frac{d\omega}{dt} \text{ or } \frac{d^2\theta}{dt^2} \text{ or } \omega\frac{d\omega}{dt}$$

if constant angular acceleration

$$\omega = \omega_0 + \alpha t$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$



$$v = r\omega$$

$$a_t = r\alpha$$

$$a_N = \omega^2 r$$

$$s = \theta r$$

$$a_N = \frac{v^2}{r}$$

$$= \frac{(r\omega)^2}{r}$$

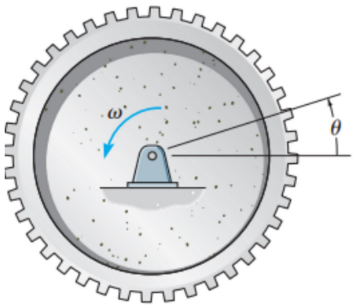
$$= \frac{r^2\omega^2}{r}$$

$$= r\omega^2$$

Tuesday, September 27, 2022 4:41 PM

Example 1:

When the gear rotates 20 revolutions after starting from rest, it achieves an angular velocity ω = 30 rad/s. Determine its constant angular acceleration and the time required.



$\omega_o = 0$

$\theta_f = 20\,rev$

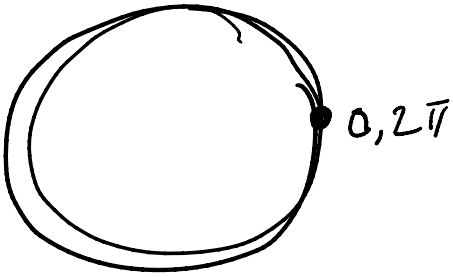
$\alpha = ?$

$t = ?$

$\omega_f = 30\,rad/s$

$20\,rev \cdot \frac{2\pi\,rad}{1\,rev}$

$\theta_f = 40\pi$



$\omega_f^2 = \omega_o^2 + 2\alpha(\theta_f - \theta_o)$

$30^2 = 0 + 2\alpha(40\pi - 0)$

$\alpha = 3.58\,rad/s^2$

$\omega_f = \omega_o + \alpha t$

$30 = 0 + 3.58t$

$t = 8.38\,s$