Chapter 6

2022年10月25日 15:13

Rotation of rigid body

① Average angular velocity

$$\omega_{ave} = \frac{\theta_f - \theta_i}{t_f - t_i} \quad s$$

② Average angular acceleration

$$\alpha_{ave} = \frac{\omega_f - \omega_i}{t_f - t_i} \quad rads^{-2}$$

① Instantaneous angular velocity

$$\omega_{ins} = \frac{d\theta}{dt} \quad rads^{-1}$$

$\frac{d}{dt}(\theta)$

② Instantaneous angular acceleration

$$\alpha_{ins} = \frac{d\omega}{dt}$$

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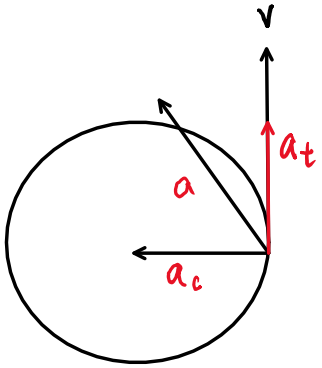
① $v = r\omega$

② $a = r\alpha$ → $a_t = r\alpha$

③ $a_c = r\omega^2$ → $a_c = \frac{v^2}{r}$

④ $s = r\theta$



$|\vec{a}| = \sqrt{a_t^2 + a_c}$

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① $v = u + at$

$\omega = \omega_0 + \alpha t$

$\omega = \omega_0 + \alpha t$

② $v^2 = u^2 + 2as$

$\omega^2 = \omega_0^2 + 2\alpha\theta$

③ $s = ut + \frac{1}{2}at^2$

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

④ $s = \frac{1}{2}(u+v)t$

$\theta = \frac{1}{2}(\omega_0 + \omega)t$

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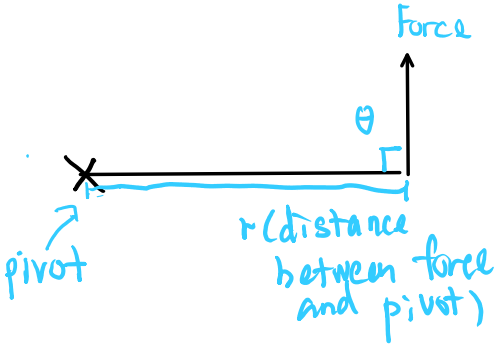
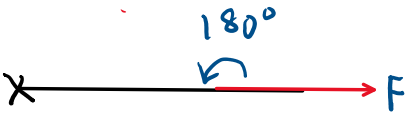
① Torque

$\tau = r F \sin\theta$

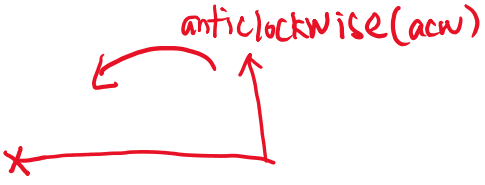
(Nm) (m) (N) angle between force and distance



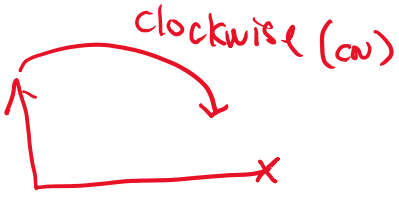


$\tau = 0$

because $\sin 180° = 0$



τ = +ve



τ = - ve

① 平移 Translation equilibrium

$$\Sigma F_{net} = 0$$

$$\Sigma F_x = 0 \qquad \Sigma F_y = 0$$

② rotational equilibrium

$$\Sigma \tau = 0$$

$$\Sigma \tau_{acw} - \Sigma \tau_{cw} = 0$$

$$\Sigma \tau_{acw} = \Sigma \tau_{cw}$$

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① Moment of Inertia

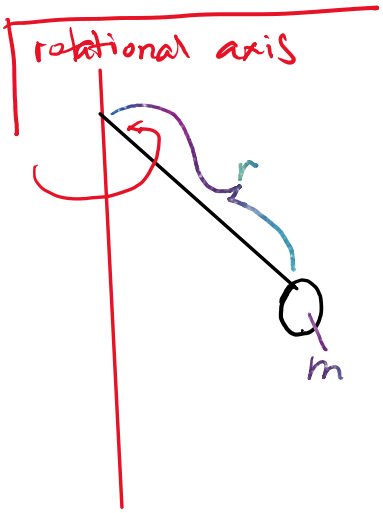
affect by
- shape body
- mass
- rotational axis

$$I = \Sigma m r^2$$

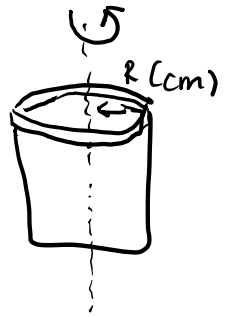
I: kgm^2

m: mass object (kg)

r: distance between object and rotational axis



① Hollow cyclindrical

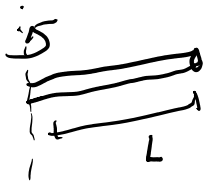


$I = MR^2$

② Solid cyclindrical

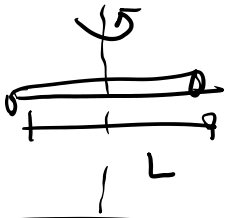
$I = \frac{1}{2} MR^2$

③



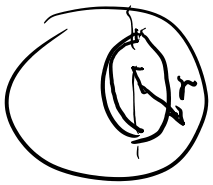
$I = \frac{1}{3} ML^2$

④



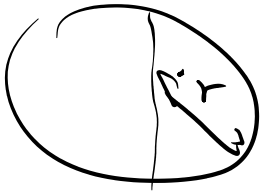
$I = \frac{1}{12} ML^2$

⑤ Hollow sphere



$I = \frac{2}{3} MR^2$

⑥ Solid sphere



$I = \frac{2}{5} MR^2$

① Linear motion = $F = ma$

② rotational motion = $T = I\alpha$ → $\left(\frac{a}{r}\right)$ → $a = r\alpha$

Nm kgm^2 $rads^{-2}$

Angular momentum

① Linear motion $p = mv$

② Angular motion $L = I\omega$

(2) Angular motion

$$L = I\omega$$

L: kgm^2s^{-1}, I: kgm^2, ω: $rads^{-1}$

(3) Conservation

$$\Sigma L_i = \Sigma L_f$$

$$I_i\omega_i = I_f\omega_f$$

$$m_i r_i^2\left(\frac{a}{r}\right) = m_f r_f^2\left(\frac{a}{r}\right)$$