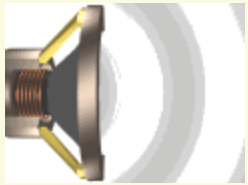
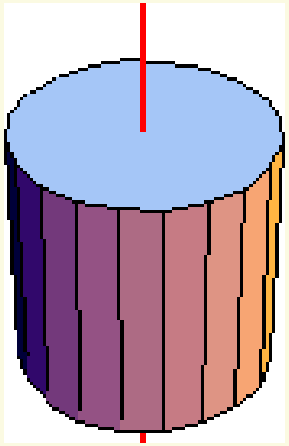


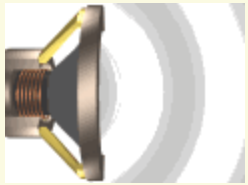
Aula 7: Movimento do corpo rígido

1. Translação e Rotação
2. Momento angular
3. Segunda lei de Newton para rotação
4. Momento de inércia de corpos homogéneos
5. Regra de Routh



Movimento do corpo rígido: animação

Simulação: rotação do corpo rígido



1. Translação e Rotação

$$v = v_0 \pm at \quad \Rightarrow \quad \frac{v}{r} = \frac{v_0}{r} \pm \frac{a}{r}t \quad \Rightarrow \quad \omega = \omega_0 \pm \varepsilon t$$

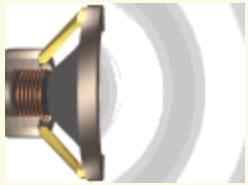
$$s = v_0 t \pm \tfrac{1}{2}at^2 \quad \Rightarrow \quad \frac{s}{r} = \frac{v_0}{r}t \pm \frac{1}{2}\frac{a}{r}t^2 \quad \Rightarrow \quad \theta = \omega t \pm \tfrac{1}{2}\varepsilon t^2$$

Translação	Rotação
m	$I = \sum mr^2$
F	$\mu = Fr$
$K = \frac{1}{2}mv^2$	$K = \frac{1}{2}I\omega^2$
$p = mv$	$L = I\omega$

Translação	Rotação
$ma = F$	$I\varepsilon = \mu$
$mv_f - mv_i = F\Delta t$	$I\omega_f - I\omega_i = \mu\Delta t$
$W = Fs$	$W = \mu\theta$
$\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = W$	$\frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2 = W$
$P = Fv$	$P = \mu\omega$

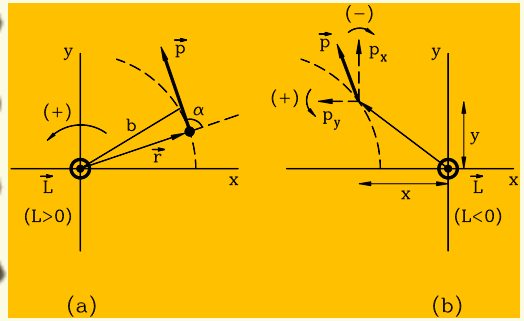
Simulação: produto vectorial

Simulação: momento de torção



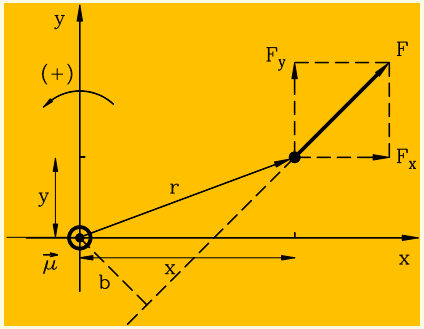
2. Momento angular

$$\vec{L} = \vec{r} \times \vec{p}$$



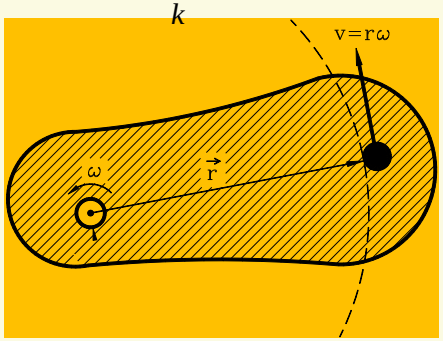
Momento de torção

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

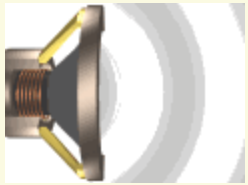


Momento de inércia

$$I = \sum_k m_k r_k^2$$



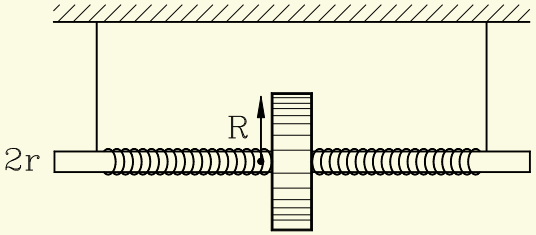
Simulação: sistema de roldanas

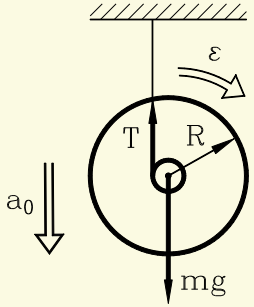


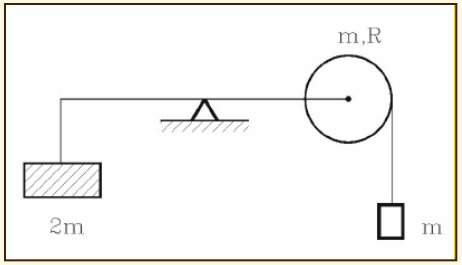
3. Segunda lei de Newton para rotação

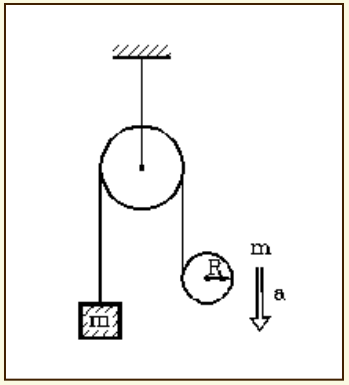
$$m\vec{a} = \sum_k \vec{F}_k \quad \rightarrow \quad I\alpha = \sum (\pm \mu_{ext})$$

Disco de Maxwell



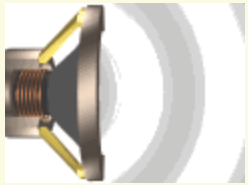




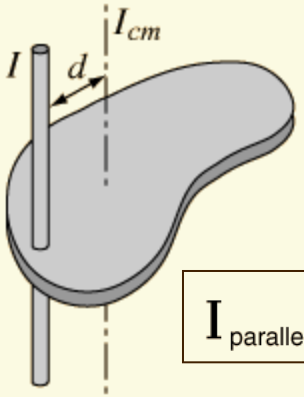


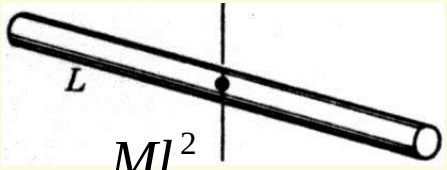
Teorema de Steiner: animação

Simulação: momento de inércia



4. Momento de inércia de corpos homogéneos

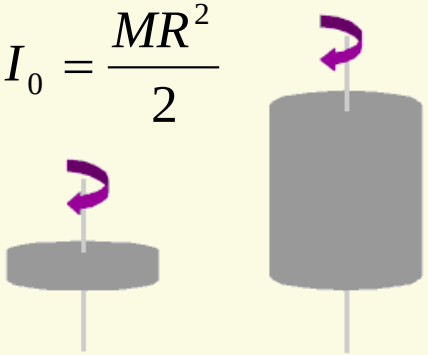


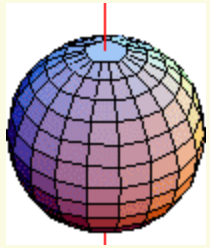


$$I_0 = \frac{Ml^2}{12}$$

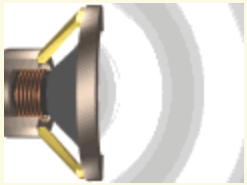
$$I_{\text{parallel axis}} = I_{cm} + Md^2$$

$$I_0 = \frac{MR^2}{2}$$

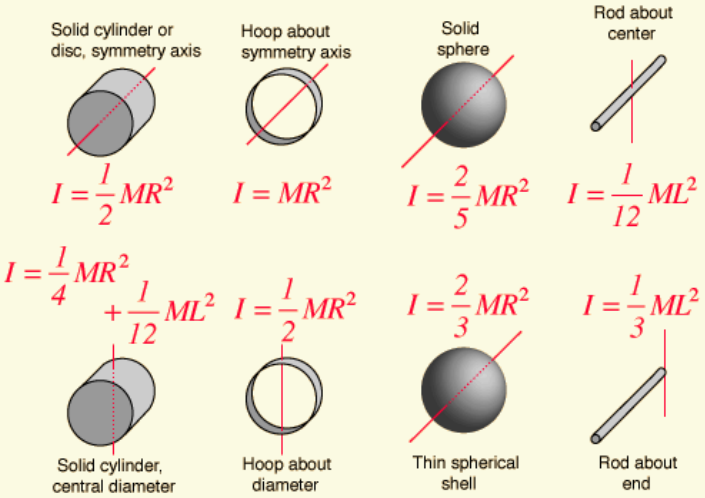




$$I_0 = \frac{2MR^2}{5}$$



5. Regra de Routh



$$I_{CM} = M\left(\frac{a^2 + b^2}{n}\right)$$

$n = 3$ para corpos *paralelepipédicos*

$n = 4$ para corpos *cilíndricos*

$n = 5$ para corpos *esféricos*