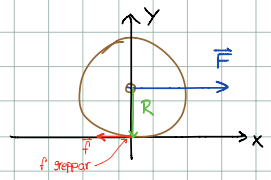
Trådrulle-föreläsning



$\vec{F} = F\,\hat{\imath}$ $\quad F>0$

$\vec{a}_{CM} = a_{CM}\,\hat{\imath}$ $\quad a_{CM}$?

$\vec{f} = f\,\hat{\imath}$ $\quad f$?

$\vec{R} = R(-\hat{\jmath})$ $\quad R>0$

$\vec{\alpha} = \alpha\,\hat{k}$ $\quad \alpha$?

$\vec{\tau} = \vec{R}\times\vec{F} \Rightarrow \vec{\alpha}$ riktas längs med $\hat{k}$

1) $\sum \vec{F}^{ext} = M\vec{a}_{CM} \Rightarrow F\hat{\imath} + f\hat{\imath} = Ma_{CM}\hat{\imath} \Rightarrow F+f = Ma_{CM}$

2) $\sum \vec{\tau}^{ext} = I\vec{\alpha}$

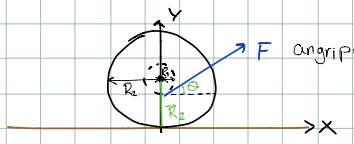
$\vec{\tau}_f = R(-\hat{\jmath})\times f\hat{\imath} = -Rf(-\hat{\jmath}\times\hat{\imath}) = Rf\,\hat{k}$

$Rf\,\hat{k} = \frac{1}{2}MR^2\vec{\alpha} = \frac{1}{2}MR^2\alpha\,\hat{k} \Rightarrow Rf = \frac{1}{2}MR^2\alpha \Rightarrow f = \frac{1}{2}MR^2\cdot\frac{a_{CM}}{R} = \frac{1}{2}Ma_{CM}$

$F+f = Ma_{CM}$
$f = -\frac{1}{2}a_{CM}$
$\Big\} F - \frac{1}{2}a_{CM} = Ma_{CM} \Rightarrow F = \frac{3}{2}Ma_{CM} \Rightarrow a_{CM} = \frac{2F}{3M} \longrightarrow F>0,\ M>0 \Rightarrow a_{CM}>0$

Nu ritar vi in f!

Trådrulle



$\vec{f} = f\,\hat{\imath}$

$F\cos\theta + f = M\,a_{CM}$

$\vec{R}_2 = R_2(-\hat{\jmath})$

$\vec{\tau}_F = R_1 F\,\hat{k}$ $\quad$ Om F fick verka ostört $\Rightarrow$ rotation moturs.

$\vec{\tau}_f = R_2(-\hat{\jmath})\times f\hat{\imath} = R_2 f\,\hat{k}$

$R_1F + R_2f = I\alpha$

Eliminera f!

$-F\cdot R_2\cos\theta - R_2\cdot f = -R_2 M a_{CM}$

$F\cdot R_1 \quad + f\cdot R_2 = I\alpha$

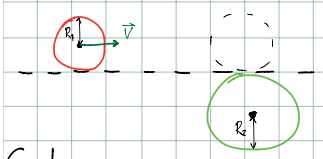
$FR_1 - FR_2\cos\theta = I\alpha - R_2 M a_{CM}$
$\alpha = \frac{-a_{CM}}{R}$
$\Big\} F(R_1 - R_2\cos\theta) = -a_{CM}\left(\frac{I}{R_2} + R_2M\right) \Rightarrow a_{CM} = \frac{R_2\cos\theta - R_1}{\frac{I}{R_2} + R_2M}\cdot F$

Nämnaren är skiträkig ty alltid >0 $\Rightarrow$ a_{CM} $\begin{cases} >0 & \text{Om } R_2\cos\theta > R_1 \\ <0 & \text{Om } R_2\cos\theta < R_1 \end{cases}$

Puckon

$m_1 = 80\,g$ $R_1 = 4\,cm$ $V = 1.5\,\frac{m}{s}$

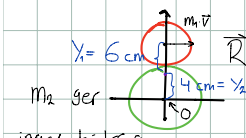
$m_2 = 120\,g$ $R_2 = 6\,cm$ **Find** ω



Calc

L bevaras

Var kommer den gemensamma tyngdpunkten vara?



$\vec{R} = \frac{m_1(R_1+R_2)}{m_1+m_2}\hat{j} = 4cm\,\hat{j}$

$L_i = L_f$

$L_f = I_{Tot}\cdot\omega$

$L_i = m_1 V \cdot Y_1 = Y_1 \cdot P_i$

I_{Tot} mha parallellaxelsatsen

$I = I_{CM} + MD^2$

$I_1 = \frac{1}{2}m_1R_1^2 + m_1Y_1^2$

$I_2 = \frac{1}{2}m_2R_2^2 + m_2Y_2^2$

$I_{Tot} = I_1 + I_2$

$\omega = \frac{L_i}{I_{Tot}}$

Vilken hastighet har ekipaget?

Rörelsemängden bevaras $\Rightarrow P_i = P_f$

$P_i = m_1 \cdot V_1$

$P_f = (m_1+m_2)V_2$

$V_2 = \frac{m_1 V}{m_1+m_2}$