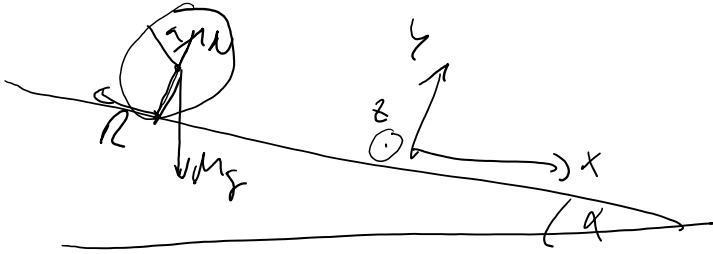


# rollender Zylinder



$$x: m \frac{d^2x}{dt^2} = mg \sin \alpha - R$$

$$y: m \frac{d^2y}{dt^2} = 0 = N - mg \cos \alpha$$

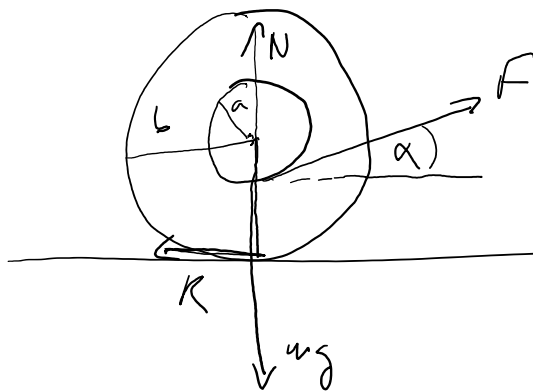
$$z: I \frac{d^2\varphi}{dt^2} = aR$$

Rollbedingung:  $x = a\varphi \rightarrow \varphi = \frac{x}{a}$

$$a \cdot R = \frac{I}{a} \cdot \frac{d^2x}{dt^2} = \frac{I}{am} (mg \sin \alpha - R)$$

$$\left(a + \frac{I}{am}\right) R = \frac{I}{a} \cdot g \sin \alpha \Rightarrow R = \frac{\frac{I}{a} g \sin \alpha}{a \left(a + \frac{I}{am}\right)}$$

# Fadenpendel



$$y: 0 = N - mg + F \sin \alpha$$

$$x: m \frac{d^2x}{dt^2} = -R + F \cos \alpha$$

$$z: I \frac{d^2\varphi}{dt^2} = -bR + aF$$

Rollbedingung:  $x = b\varphi \rightarrow \varphi = \frac{x}{b}$

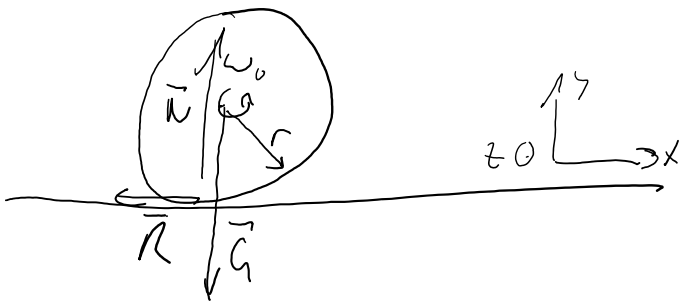
$$\frac{d^2x}{dt^2} = -\frac{R}{m} + \frac{F}{m} \cos \alpha = \frac{1}{m} (-R + F \cos \alpha)$$

$$= \frac{-b^2 R + ab F}{I} = -\frac{b^2}{I} \left( R - \frac{a}{b} F \right)$$

$$R - \frac{a}{b} F = \frac{I}{b^2 m} (R - F \cos \alpha)$$

$$R \left( 1 - \frac{I}{b^2 m} \right) = F \left( \frac{a}{b} - \cos \alpha \right)$$

$$R = 0 \quad \text{wenn} \quad \frac{a}{b} = \cos \alpha$$



$$x: m \frac{d^2 x}{dt^2} = -R = m \frac{dv}{dt}$$

$$z: I \cdot \frac{d\omega}{dt} = -v R = \frac{m r^2}{2} \frac{d\omega}{dt}$$

$$\approx \frac{m r}{2} \frac{dv}{dt}$$

Rollbed.

$$v_s = -\frac{R}{m} t$$

$$\omega = \omega_0 - \frac{r R}{I} t$$

Rollen wenn  $v_s = r \omega \rightarrow \frac{dx_s}{dt} = v \frac{d\varphi}{dt}$

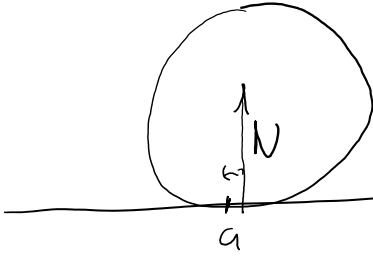
$$r \omega = -\frac{R}{m} t = r \omega_0 - \frac{r^2 R}{I} t \quad I = \frac{m r^2}{2}$$

$$-\frac{R}{m} t = r \omega_0 - \frac{2R}{m} t$$

$$\frac{R}{m} t = r \omega_0 \rightarrow t_R = \frac{r \omega_0 m}{R}$$

# Rollreibung

$$|\vec{M}| = a N = \frac{d\vec{L}}{dt} = \frac{dI\omega}{dt} = \frac{m}{2} r \cdot \frac{dv}{dt}$$



$$\rightarrow R_{\text{Roll}} = \frac{2a}{r} N$$