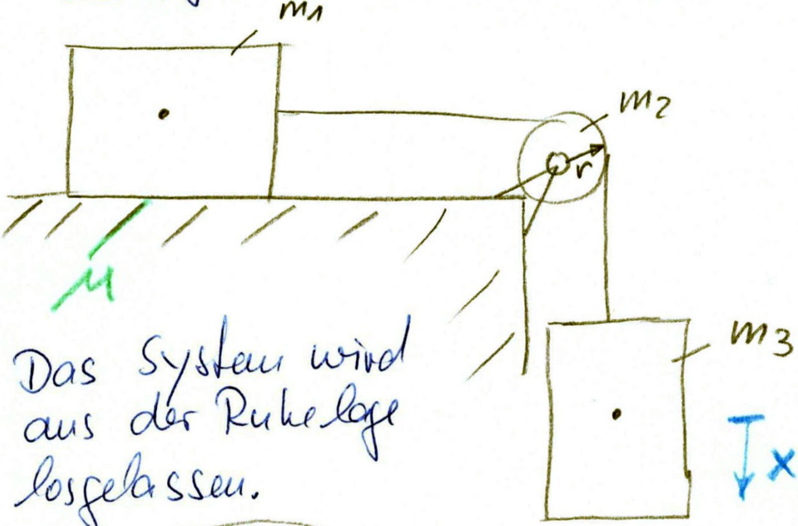
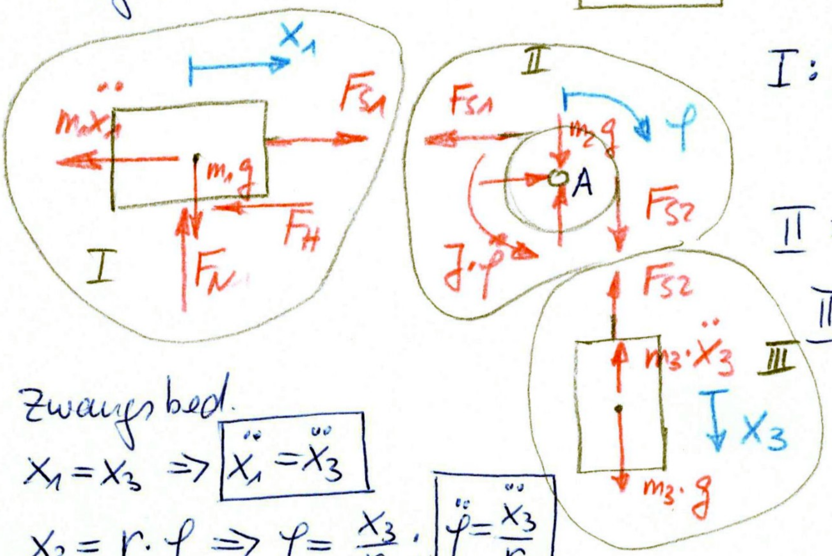
Aufgabe zu d'Alembert



Ges: $m_1 = 10\,kg$
$m_3 = 80\,kg$
$m_2 = 1\,kg$
$r = 0{,}05\,m$
$\mu = 0{,}06$

Ges: $\ddot{x}_3$

Das System wird aus der Ruhelage losgelassen.



$$\text{I}: \rightarrow: F_{S1} - F_H - m_1\ddot{x}_1 = 0$$
$$\uparrow: F_N - m_1\cdot g = 0$$
$$\text{II}: \curvearrowleft A: J\cdot\ddot{\varphi} + F_{S1}\cdot r - F_{S2}\cdot r = 0$$
$$\text{III}: \uparrow: F_{S2} + m_3\ddot{x}_3 - m_3\cdot g = 0$$

Zwangsbed.
$$x_1 = x_3 \Rightarrow \boxed{\ddot{x}_1 = \ddot{x}_3}$$
$$x_3 = r\cdot\varphi \Rightarrow \varphi = \frac{x_3}{r}; \quad \boxed{\ddot{\varphi} = \frac{\ddot{x}_3}{r}}$$

Massenträgheitsmoment $J = \frac{1}{2}m_2 r^2$

Coulomb: $F_H = \mu\cdot F_N$

$$J\cdot\ddot{\varphi} + F_{S1}\cdot r - F_{S2}\cdot r = 0$$
$$\frac{1}{2}m_2 r^{\cancel{2}}\cdot\frac{\ddot{x}_3}{\cancel{r}} + (F_H + m_1\ddot{x}_3)\cdot\cancel{r} - (m_3\cdot g - m_3\ddot{x}_3)\cdot\cancel{r} = 0$$
$$\frac{1}{2}m_2\ddot{x}_3 + \mu\cdot m_1 g + m_1\ddot{x}_3 - m_3\cdot g + m_3\ddot{x}_3 = 0$$
$$\ddot{x}_3\left(\frac{m_2}{2} + m_1 + m_3\right) = m_3\cdot g - \mu\cdot m_1\cdot g$$
$$\ddot{x}_3 = \frac{g(m_3 - \mu\cdot m_1)}{\frac{m_2}{2} + m_1 + m_3} = \underline{8{,}6\,\frac{m}{s^2}}$$

Aufgabe 4-6

System II = III

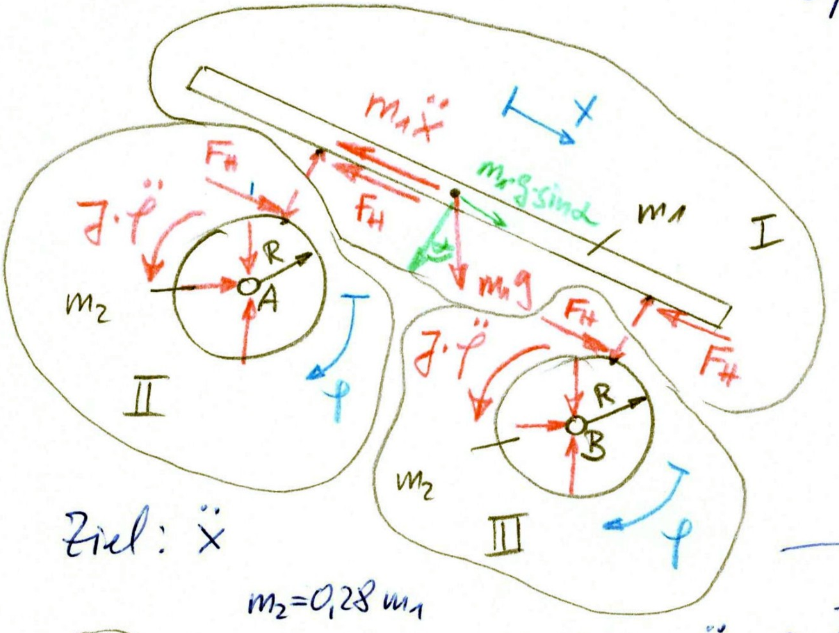
I: $\nwarrow$: $m_1\ddot{x} + 2F_H - m_1 g\sin\alpha = 0$

II: $\curvearrowleft A$: $J\ddot{\varphi} - F_H \cdot R = 0$

$$J = \frac{1}{2} m_2 R^2$$

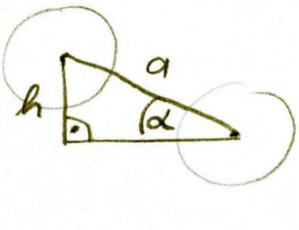
$$x = R\cdot\varphi$$

$$\varphi = \frac{x}{R}\ ; \quad \boxed{\ddot{\varphi} = \frac{\ddot{x}}{R}}$$



Ziel: $\ddot{x}$

$m_2 = 0{,}28\, m_1$



$\sin\alpha = \frac{h}{a}$

$\sin\alpha = 0{,}5$

$\alpha = 30°$

$$m_1\ddot{x} + 2\,\frac{J\cdot\ddot{\varphi}}{R} - m_1 g\cdot\sin\alpha = 0$$

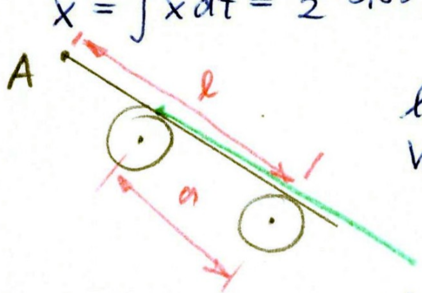
$$m_1\ddot{x} + \cancel{2}\,\frac{\frac{1}{\cancel{2}} m_2 \cancel{R^2}\cdot\frac{\ddot{x}}{\cancel{R}}}{\cancel{R}} = m_1 g\sin\alpha$$

$$\cancel{m_1}\ddot{x} + 0{,}28\cancel{m_1}\ddot{x} = \cancel{m_1} g\sin\alpha$$

$$1{,}28\,\ddot{x} = g\cdot 0{,}5$$

$$\ddot{x} = \frac{9{,}81\,\frac{m}{s^2}\cdot 0{,}5}{1{,}28} = 3{,}83\,\frac{m}{s^2}$$

$$\left.\begin{array}{l} \dot{x} = \int \ddot{x}\,dt = 3{,}83\,\frac{m}{s^2}\cdot t \\ x = \int \dot{x}\,dt = \frac{1}{2}\cdot 3{,}83\,\frac{m}{s^2}\cdot t^2 \end{array}\right\}\ \text{Konst. sind "Null".}$$



$l = 1{,}5a$

Weg ist: $l - a$; $s = 0{,}5a$; $a = 1m$; $s = 0{,}5m$

a) $s = \frac{3{,}83}{2}\,\frac{m}{s^2}\cdot t^2 \rightarrow t = \sqrt{\frac{s}{1{,}915}} = \sqrt{\frac{0{,}5}{1{,}915}}\,s = 0{,}51\,s$

b) $\dot{x} = v = 3{,}85\,\frac{m}{s^2}\cdot 0{,}51\,s = 1{,}97\,\frac{m}{s}$