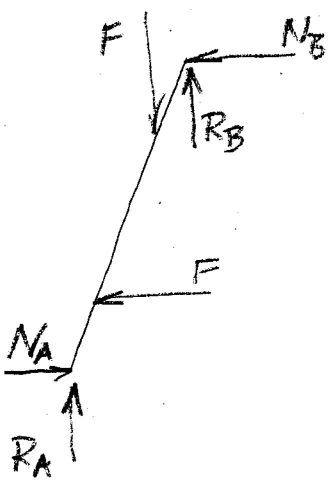
$\boxed{1}$



$$\underset{①}{N_A - N_B = F} \quad \underset{②}{R_A + R_B = F} \quad \underset{③}{R_A = \mu N_A} \quad \underset{④}{R_B = \mu N_B}$$

$$\frac{1}{8} F c_\alpha - \frac{7}{8} F s_\alpha + R_B s_\alpha + N_B c_\alpha = 0 \quad ⑤$$

, mit
$c_\alpha := \cos\alpha$
$s_\alpha := \sin\alpha$
$t_\alpha := \tan\alpha$

②,③ $R_B = F - \mu N_A$

$④ \overset{①}{=} F - \mu\left(F + \frac{1}{\mu} R_B\right)$

$$\underline{\underline{R_B = \frac{1-\mu}{2} \cdot F}}$$
$$\underline{\underline{N_B = \frac{1-\mu}{2\mu} \cdot F}}$$

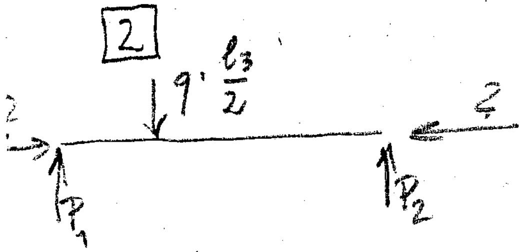
} in ⑤: $\frac{1}{8} c_\alpha - \frac{7}{8} s_\alpha + \frac{1-\mu}{2} s_\alpha + \frac{1-\mu}{2\mu} c_\alpha = 0$

$$\frac{1}{\mu} - \frac{3}{4} - \mu t_\alpha - \frac{3}{4} t_\alpha = 0$$

$$\mu^2 + \underbrace{\frac{3}{4}\left(1 + \frac{1}{t_\alpha}\right)}_{\beta} \mu - \frac{1}{t_\alpha} = 0$$

$$\underline{\underline{\mu = -\frac{\beta}{2} + \sqrt{\frac{\beta^2}{4} + \frac{1}{t_\alpha}}}}$$

$\boxed{2}$



a) $P_1 = \frac{1}{3} q l_3 \qquad P_2 = \frac{1}{6} q l_3$

Abkürzung $B := EJ$

b) aus Tabelle:

$$P_{krit\,1} = \pi^2 \frac{B_1}{0{,}7^2 \cdot l_1^2}$$

$$P_{krit\,2} = \pi^2 \frac{B_2}{l_2^2}$$

c) $\nu_1 = \frac{P_{krit\,1}}{P_1} \overset{!}{=} \frac{P_{krit\,2}}{P_2} = \nu_2$

$$\underline{\underline{\frac{B_1}{B_2} = 2 \cdot 0{,}7^2 \cdot \left(\frac{l_1}{l_2}\right)^2}}$$

3

a) $\underline{x}_A(t) = l_1 \cdot \underline{e}_r(t)$

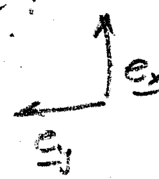
$\underline{e}_r = \begin{pmatrix} \cos\varphi \\ \sin\varphi \end{pmatrix}$

b) $\underline{\dot{x}}_A = l_1 \dot{\varphi}\, \underline{e}_\varphi$

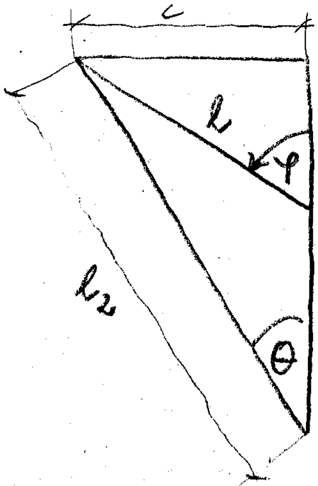
$\underline{e}_\varphi = \begin{pmatrix} -\sin\varphi \\ \cos\varphi \end{pmatrix}$

$\underline{\ddot{x}}_A = l_1 \left(\ddot{\varphi}\, \underline{e}_\varphi - \dot{\varphi}^2 \underline{e}_r \right)$

bezogen auf:



c) Kosinussatz $l^2 = l_2^2 + a^2 - 2a\, l_2 \cos\theta$

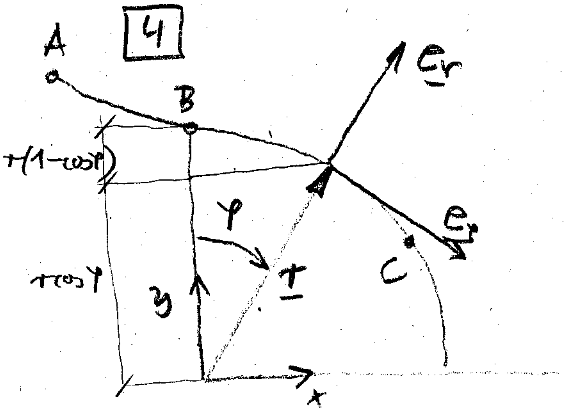


$c = l_2 \cdot \sin\theta$, mit $\theta = \omega \cdot t$

$\sin\varphi = \dfrac{c(t)}{l(t)} = \dfrac{l_2 \sin(\omega t)}{\sqrt{l_2^2 + a^2 - 2a\, l_2 \cos(\omega t)}}$

$\varphi(t) = \operatorname{asin}\left\{ \dfrac{l_2 \sin(\omega t)}{\sqrt{}} \right\}$

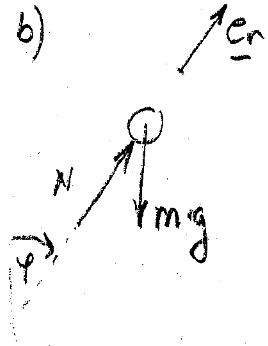
4



a) $\frac{1}{2} m v_B^2 = mgh$

$v_B = \sqrt{2gh}$

b)



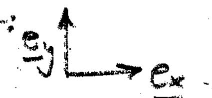
$\underline{r} = r\, \underline{e}_r$

$\underline{\dot{r}} = r \dot{\varphi}\, \underline{e}_\varphi$

$\underline{\ddot{r}} = r \ddot{\varphi}\, \underline{e}_\varphi - r \dot{\varphi}^2 \underline{e}_r$

$\underline{e}_r = \begin{pmatrix} \sin\varphi \\ \cos\varphi \end{pmatrix}$ $\underline{e}_\varphi = \begin{pmatrix} \cos\varphi \\ -\sin\varphi \end{pmatrix}$

bezogen auf:



$\underline{e}_r: \quad -m r \dot{\varphi}^2 = N - mg\cos\varphi \quad (1)$

$\underline{e}_\varphi: \quad m r \ddot{\varphi} = mg \sin\varphi$

$\frac{1}{2} m v_B^2 = \frac{1}{2} m (r\dot{\varphi})^2 + mg r (\cos\varphi - 1)$

$m(r\dot{\varphi})^2 = m v_B^2 + 2mgr(1-\cos\varphi)$

$r\dot{\varphi} = \sqrt{2gh + 2gr(1-\cos\varphi)}$

$r\dot{\varphi}$ in (1): $N = mg\cos\varphi - m2g\left(\frac{h}{r} + 1 - \cos\varphi\right)$

$N = mg\left(3\cos\varphi - 2 - 2\frac{h}{r}\right)$

c) $N = 0$ $\quad 3\cos\varphi_c - 2\left(1 + \frac{h}{r}\right)$

$\cos\varphi_c = \frac{2}{3}\left(1 + \frac{h}{r}\right)$