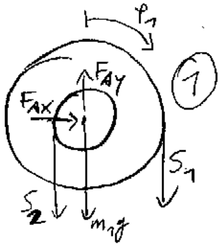
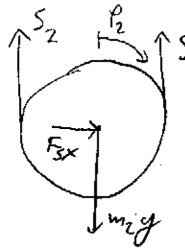
1

a) I:



(1) Pkt.

II:



(1) Pkt.

$$r_2 = \frac{r+R}{2}$$

DS:

$$-\Theta_{AA}^{1}\ddot{\varphi}_1 = -S_1 \cdot R + S_2 \cdot r$$

SS:

$$m_1 \ddot{x}_1 = F_{Ax}$$

$$m_1 \ddot{y}_1 = -S_1 - S_2 - m_1 g + F_{Ay}$$

(1) Pkt

DS:

$$-\Theta_{SS}^{2}\ddot{\varphi}_2 = S_2 r_2 - S_1 r_2$$

$$m_2 \ddot{x}_2 = F_{Sx}$$

$$m_2 \ddot{y}_2 = S_1 + S_2 - m_2 g$$

(1) Pkt.

11 Unbekannte, 6 Glgn. $\Rightarrow$ 5 kinematische Beziehungen nötig

b)

$$v_1 = r\,\omega_1 \qquad v_2 = -R\omega_1$$

$$v_1 = v_S + r_2\omega_2 \qquad v_2 = v_S - r_2\omega_2$$

$$\Rightarrow \omega_1 = \omega_2$$

$$\omega_1 = \frac{2}{r-R} v_S$$

(1) Pkt. mit richtiger Herleitung

$$\ddot{x}_1 = \ddot{x}_2 = \ddot{y}_1 = 0$$

(1) Pkt.

c)

$$\dot{v}_S = \underbrace{\frac{m_2 g \left(\frac{R-r}{2}\right)}{\left(\Theta_{AA}^{1} + \Theta_{SS}^{2}\right)\frac{2}{r-R} - m_2 R + \frac{r+R}{2} m_2}}_{K}$$

(2) Pkt. nach Ermessen

Integration:

$$v_S = K \cdot t + C$$

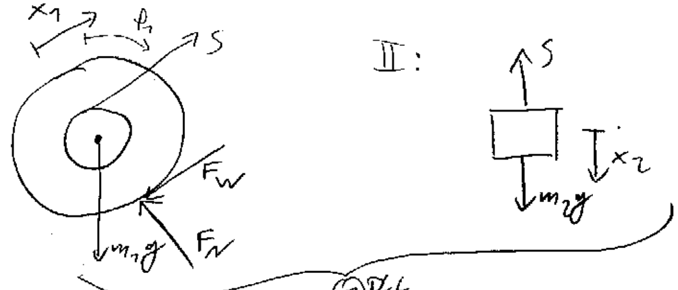
$$\text{mit } v_S(t=0) = 0 \Rightarrow C = 0$$

(1) Pkt

Σ 11 Pkt.

2

a)



(1) Pkt.

DS:

$$-\Theta_{SS}\ddot{\varphi}_1 = -F_W \cdot R - S \cdot r$$

SS:

$$m_1 \ddot{x}_1 = S - F_W - m_1 g \sin(\alpha)$$

SS:

$$m_2 \ddot{x}_2 = m_2 g - S$$

(2)

3 Glgn. $\Rightarrow$ 2 Pkte.

kinematische Beziehungen:

$$x_1 = \varphi_1 R \Rightarrow \ddot{\varphi}_1 = \frac{\ddot{x}_1}{R}$$

(1) Pkt.

$$x_2 = x_1 + \varphi_1 \cdot r \Rightarrow \ddot{x}_2 = \ddot{x}_1\left(1 + \frac{r}{R}\right)$$

(1) Pkt.

b)

$$\ddot{x}_1 = \frac{m_2 g(R+r) - m_1 g R \sin(\alpha)}{\underbrace{\frac{\Theta_{SS}}{R} + m_2 R + 2 m_2 r + m_1 R + m_2 \frac{r^2}{R}}_{K}}$$

(2) nach Ermessen

Integration:

$$x_1(t) = \frac{1}{2}\,\frac{m_2 g(R+r) - m_1 g R \sin(\alpha)}{K}\, t^2 + C_1 t + C_2$$

(1) Pkt

aus

$$x_1(t=0) = x_0 \Rightarrow C_2 = x_0$$

$$\dot{x}_1(t=0) = v_0 \Rightarrow C_1 = v_0$$

(1) Pkt.

c)

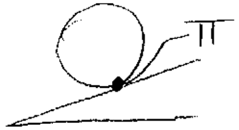
$$S = m_2 g - \frac{m_2\left(1 + \frac{r}{R}\right)\cdot\left[m_2 g(R+r) - m_1 g R \sin\alpha\right]}{K}$$

(1) Pkt

Bedingung: $\underbrace{\ddot{x}_1 < 0}_{(1)\,\text{Pkt}} \Rightarrow m_2 g(R+r) - m_1 g R \sin(\alpha) < 0$

$$m_2 < m_1 \frac{R \sin(\alpha)}{(R+r)}$$

(1) Pkt.

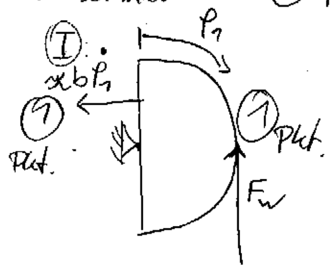
d) 

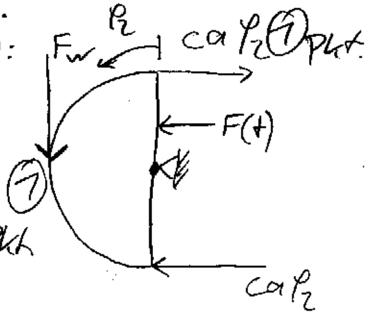
(1) Pkt.

3

a) $\underbrace{\Theta_{AA} = \Theta_{BB} = \Theta_{SS} + b^2 m}_{(1)\ \text{Pkt}}$; $\varphi_1 = \varphi_2$ (1) Pkt

Freischnitte:

I: 

II: 

je einen Punkt für richtigen Freischnitt und je einen für richtige Kräfte

DS:

$-\Theta_{AA}\ddot{\varphi}_1 = \varkappa\dot{\varphi}_1 b^2 + F_w \cdot a$ (1) Pkt. $\Theta_{BB}\ddot{\varphi}_2 = -2c\varphi_2 a^2 + F_w \cdot a + F(t)\cdot b$ (1) Pkt.

$$\Rightarrow \ddot{\varphi}_1 + \frac{\varkappa b^2}{(\Theta_{AA}+\Theta_{BB})}\dot{\varphi}_1 + \frac{2ca}{(\Theta_{AA}+\Theta_{BB})}\varphi_1 = \frac{b\,F_0}{(\Theta_{AA}+\Theta_{BB})}\cos(\Omega t)$$ (1) Pkt

b)
$$2\delta = \frac{\varkappa b^2}{(\Theta_{AA}+\Theta_{BB})}$$
$$\omega_d = \sqrt{\frac{\varkappa^2 b^4}{4(\Theta_{AA}+\Theta_{BB})^2} - \frac{2ca^2}{(\Theta_{AA}+\Theta_{BB})}}$$
(1) Pkt.

Allg. Lösung:

$$\varphi_1(t) = e^{-\delta t}\left(A\cos(\omega_d t) + B\sin(\omega_d t)\right)$$
$$\varphi_1(t=0) = \varphi_0 = A$$
$$\dot{\varphi}_1(t=0) = -\delta A + \omega_d B = 0 \quad \Rightarrow \quad B = \frac{\delta\varphi_0}{\omega_d}$$

(2) Pkt nach Ermessen

c) $e^{-\delta t} \to 0$ für $t \to \infty$ (1) Pkt.

Ansatz: $\varphi_1(t) = \hat{\varphi}\cos(\Omega t - \alpha)$

$$\tan(\alpha) = \frac{\varkappa b^2 \Omega}{2ca^2 - \Omega^2(\Theta_{AA}+\Theta_{BB})}$$ (1) Pkt.

$$\hat{\varphi} = \frac{b\,F_0}{-(\Theta_{AA}+\Theta_{BB})\cos(\alpha)\Omega^2 + \varkappa b^2\Omega\sin(\alpha) + 2ca^2\cos(\alpha)}$$ (1) Pkt

(1) Pkt. für die 2 Gleichungen für α und $\hat{\varphi}$